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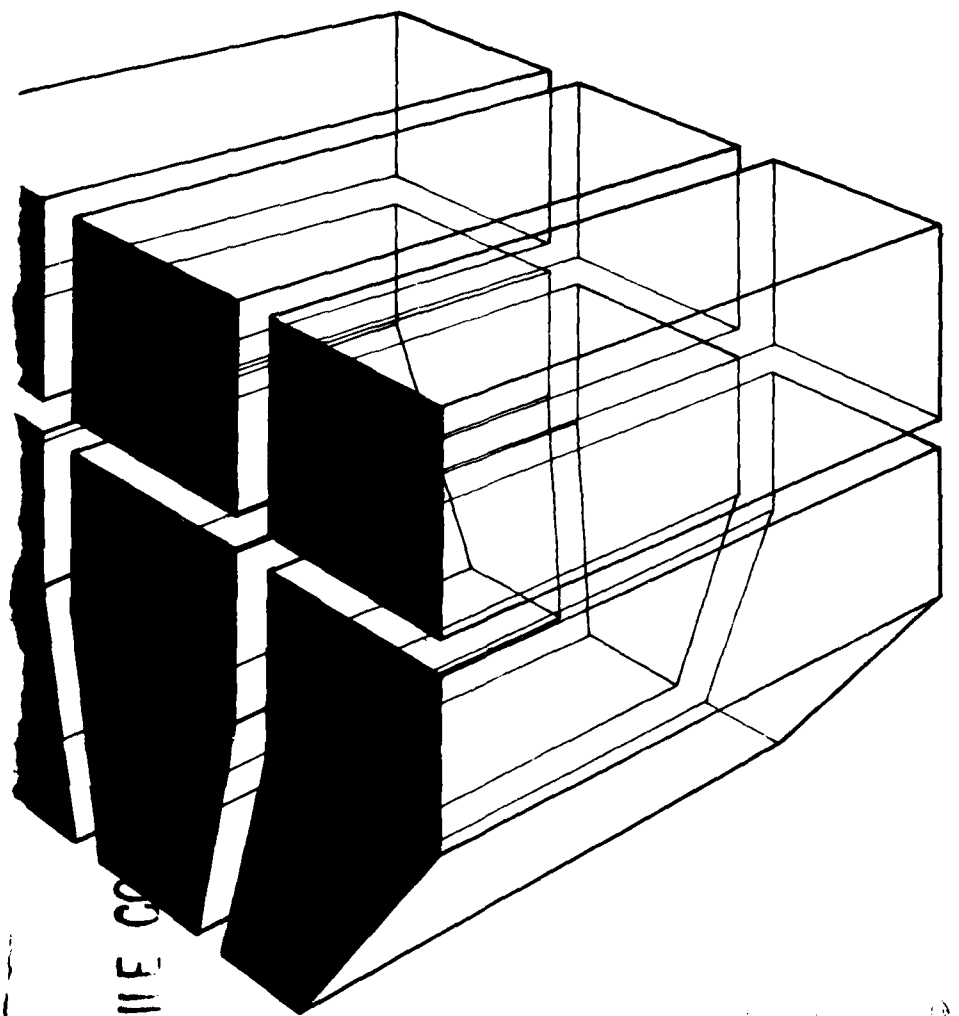
PLANNING FOR OFF-ROAD RECREATIONAL VEHICLE USE ON ARMY INSTALLATIONS



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Since 1978, the U.S. Army Construction Engineering Research Laboratory has been conducting research to help installation personnel comply with the policies, procedures, and criteria of Army Regulation 210-9, Use of Off-Road Vehicles on Army Lands. This report represents a synthesis of the results of this research. It describes a general process and some specific considerations for planning for off-road recreational vehicle (ORRV) use on Army lands.

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The general process described applies to all types of ORRVs. User preferences, land and recreational use compatibility, environmental assessment, and trail development are several of the factors considered in the process. Special considerations included are variations in procedure and planning criteria due to vehicle type, planning for uncommon vehicles (e.g., swamp buggies), and noncompetitive vs. competitive use.

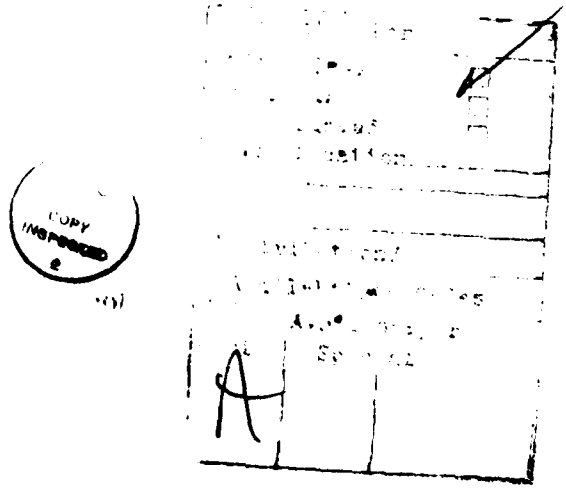
Recreation planners and land management personnel will be the primary users of this report. They will obtain the best results through cooperative use of the information, thus providing ORRV use opportunities while considering natural and integrated resource management.

FOREWORD

This investigation was performed for the Directorate of Military Programs, Office of the Chief of Engineers (OCE), under Project No. 4A762720A896, "Environmental Quality for Construction and Operation of Military Facilities"; Task B, "Land Use Planning"; Work Unit 036, "Management of Training Area Environments." The applicable QCR is 3.01.001. The OCE Technical Monitor was Mr. Donald Bandel, DAEN-MPO-B.

The investigation was performed by the Environmental Division (EN), U.S. Army Construction Engineering Research Laboratory (CERL). The assistance and technical advice of several personnel from CERL-EN is gratefully acknowledged: Mr. R. S. Baran, Mr. D. J. Hunt, Mr. J. C. McBryan, Dr. R. Raspet, and Dr. P. D. Schomer. Other persons providing significant input are listed in Appendix E.

Dr. R. K. Jain is Chief of EN. COL Louis J. Circeo is Commander and Director of CERL and Dr. L. R. Shaffer is Technical Director.



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1 INTRODUCTION

Background

In recent years, use of off-road vehicles (ORVs) for recreation has become both popular and controversial. In a recreational context, an ORV is defined as any motorized vehicle designed primarily for, or capable of, cross-country travel on or immediately over land, water, snow, ice, marsh, swampland, or other natural terrain. This definition excludes any registered motorboat; any military, fire, ambulance, or law enforcement vehicle when used for emergency purposes; any combat or combat support vehicle when used for national defense; and any vehicle authorized for official use. Off-road recreational vehicles (ORRVs) include trailbikes, dune buggies, all-terrain vehicles, swamp buggies, and many more.

A 1979 Council on Environmental Quality (CEQ) publication estimated that there were about 10 million ORVs in the United States that were being used as ORRVs.[1] Widespread use of these vehicles has become controversial due to frequent conflict with wise land and resource management practices. In recognition of this conflict, Presidential Executive Orders (EOs) 11644 and 11989[2] were issued to direct Federal agencies in managing ORRVs.

In response to these EOs, Army Regulation (AR) 210-9 was issued in 1975 and revised 1 July 1978.[3] AR 210-9 establishes Army policies, procedures, and criteria for controlling off-road travel by ORRVs, and prescribes appropriate operating conditions for such vehicles. It also charges Army personnel with determining the suitability of installation lands for ORRV use.

The goal of the EOs and the AR is to provide suitable ORRV use enjoyment while considering the long-term stability of environmental resources. To help Army personnel comply with these mandates and attain this goal, researchers at the U.S. Army Construction Engineering Research Laboratory (CERL) have developed a process for planning for ORRV use on installation lands.

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[1] David Sheridan, Off-Road Vehicles on Public Land (President's Council on Environmental Quality, 1979), p 2.

[2] Executive Order 11644, "Use of Off-Road Vehicles on Public Lands," Federal Register, Vol 37, No. 27 (8 February 1972), pp 2877-2878; and Executive Order 11989, "Off-Road Vehicles on Public Lands," Federal Register, Vol 42, No. 101 (24 May 1977), pp 26959-26960.

[3] Installations -- Use of Off-Road Vehicles on Army Lands, Army Regulation (AR) 210-9 (Department of the Army, 1 July 1978).

Purpose

The purpose of this report is to describe the process developed for ORRV use planning and to provide related information pertinent to different types of vehicles and to competitive and noncompetitive uses.

Approach

The process and planning considerations were developed by theoretically and subjectively analyzing the results of CERL research conducted since 1978. The following research efforts and results were used in this development:

1. Installation resource managers were surveyed to determine major areas of natural resource management conflict; ORRV use was identified as one of the major areas of conflict.*

2. A literature search was conducted and existing ORRV management programs were examined to identify and analyze techniques for ORRV area planning, evaluation, and management. No programs were found that met the overall requirements of AR 210-9.

3. A land evaluation method was developed through adaptation of existing techniques and development of additional techniques that address Army-unique requirements. This initial method was oriented toward evaluation of areas for noncompetitive trailbike use.[4] This method was field-tested and appropriate modifications and refinements were made.[5]

4. Additional literature and programs were examined to modify this method for other types of vehicles. Modification was oriented toward noncompetitive snowmobile and four-wheel drive (4WD) vehicle use.[6]

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* This report addresses only the ORRV conflict. Other major areas of conflict that were identified are addressed in other CERL research and reports. (See Chapter 2, p 10, and the Bibliography.)

[4] Evaluation of Areas for Off-Road Recreational Motorcycle Use, Engineer Technical Note (ETN) 80-9 (Department of the Army, Office of the Chief of Engineers, 4 March 1980).

[5] R. M. Lacey, H. E. Balbach, R. S. Baran, and R. G. Graff, Evaluation of Areas for Off-Road Recreational Motorcycle Use, Volume I: Evaluation Method, Technical Report N-86/ADA096528 (U.S. Army Construction Engineering Research Laboratory [CERL], 1980); R. M. Lacey and H. E. Balbach, Evaluation of Areas for Off-Road Recreational Motorcycle Use, Volume II: Alternate Soil Suitability Determination Methods, Technical Report N-86/ADA096529 (CERL, 1980).

[6] R. M. Lacey, R. S. Baran, W. D. Severinghaus, and D. J. Hunt, Evaluation of Lands for Recreational Snowmobile Use, Technical Report N-105/ADA101075 (CERL, 1981); R. M. Lacey and W. D. Severinghaus, Evaluation of Lands for Off-Road Recreational Four-Wheel Drive Vehicle Use, Technical Report N-110 (CERL, 1981).

5. A supplemental survey of installation land management and outdoor recreation personnel was conducted to identify installation experiences with competitive ORRV use.[7]

6. Additional literature review identified a state-of-the-art process for general outdoor recreation planning. This process was determined to be applicable to installation outdoor recreation planning.[8]

7. Additional literature was reviewed to determine any special considerations needed for uncommon types of ORRVs (e.g., all-terrain vehicles).

Scope

The process and considerations described in this report are intended only to provide a general planning framework and useful information for ORRV planning; the results are not intended as official guidance. For all factors addressed here (e.g., environmental impact assessment, official planning documents, inspection, and violations) the policies and procedures in appropriate Department of Defense directives and ARs apply.

Mode of Technology Transfer

Information in this report will be issued as an Engineer Technical Note.

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[7] R. M. Lacey, H. E. Balbach, D. J. Hunt, and W. D. Severinghaus, "Off-Road Competitive Events on Military Installations," in Agronomy Abstracts, 1980 Annual Meetings of the American Society of Agronomy (American Society of Agronomy, December 1980).

[8] R. M. Lacey and W. D. Severinghaus, Application of the Recreation Opportunity Spectrum for Outdoor Recreation Planning on Army Installations, Technical Report N-124/ADA114892 (CERL, 1982).

2 GENERAL DISCUSSION

Introduction

The ORRV planning process is similar to that of any other type of planning. Its components are defined by the following planning framework:

1. Develop goals and objectives

2. Identify problems and opportunities

3. Systematically collect and analyze data

4. Develop, evaluate, and test alternative courses of action or resource allocation

5. Develop a long-range plan

6. Identify and develop implementation procedures

7. Refine and update plan components

8. Insure a continuing process.

The diversity of various installations' resources, missions, and policies prohibits detailed discussion of each framework component. However, the information provided in this and CERL Technical Reports N-86, N-105, and N-110 can be helpful for addressing the various tasks implied by each component.

Components 1 and 2, above, are among the most difficult planning tasks due to the lack of information relative to responsibilities, problems, and opportunities. These difficulties also result from the lack of a truly integrated approach to planning and management.

The following sections provide information that will help the user address components 1 and 2. The final section suggests a method for interfacing ORRV planning with other outdoor recreation planning and integrated resource management.

Rationale for Planning

Before addressing components 1 and 2, the obvious question is, why plan for ORRV use? First, Army Regulation 210-9 requires some degree of ORRV planning, and second, unauthorized, improperly managed ORRV use often conflicts with other natural resource management objectives. These responses, together, support and become the rationale for ORRV planning.

The Purview for Planning

The executive and regulatory mandates identified on page 7 require that Army lands be evaluated to determine their suitability for ORRV use. Several other Army regulations also establish responsibility and provide authority for ORRV planning.

Foremost among these regulations is AR 28-1, which states: "Commanders should insure that, where possible, land and water resources under their control are used for constructive outdoor recreation activities."[9] This allows for the development of on-post recreation areas and facilities. AR 28-1 further states that, "Outdoor recreation facilities include ... Trails for hiking, horseback riding, bicycling, and off-road vehicles" and "Motor activities and vehicle racing facilites for motorcycling, auto racing, etc."[10]

AR 405-80 allows for nonrecreational (i.e., competitive) use of ORRVs on installation lands. It states that, "In rare instances, the use of Army real property for vehicle speed contests will be approved."[11] Research indicates that ORRV competition occurs on installation lands; in fact, trailbike events occur quite often (p 32).

AR 420-74 also addresses the need for appropriate planning and coordination of recreational and competitive ORRV use.[12] This regulation states that, "Land and water areas designated for off-road vehicle use will be included in the installation Natural Resources Management Plan and the Installation Master Plan." AR 210-20 also recognizes general recreation maps and plans, which should include any ORRV use area, as basic information requirements for installation master planning.[13]

Resource Conflict Resolution

The objectives of installation natural resource management are to develop, initiate, and maintain progressive programs for land management and utilization and to maintain, protect, and improve environmental qualities, aesthetic values, and ecological relationships.[14] The many uses of Army land — both in support of National Defense and as a trusteeship of publicly owned land -- make it difficult to accomplish these objectives successfully. This often results from conflicts between land use and natural resources management.

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[9] Welfare, Recreation, and Morale -- Army Morale Support Activities, AR 28-1 (Department of the Army, 1 January 1979), p 5-4.

[10] Welfare, Recreation, and Morale -- Army Morale Support Activities, p 5-5.

[11] Real Estate -- Granting Use of Real Estate, AR 405-80 (Department of the Army, 1 February 1979), p 4-2.

[12] Facilities Engineering -- Natural Resources: Land, Forest, and Wildlife Management, AR 420-74 (Department of the Army, 1 July 1977), p 7-1.

[13] Installations -- Master Planning for Army Installations, AR 210-20 (Department of the Army, 26 January 1976), pp 2-7 and 3-5.

[14] Facilities Engineering -- Natural Resources: Land, Forest, and Wildlife Management, AR 420-74 (Department of the Army, 1 July 1977), p 1-1.

In a 1978 survey of 22 Army natural resource management offices, CERL identified the existence and commonality of many resource use and management conflicts. One conflict was between authorized and unauthorized ORRV use on Army lands. Survey respondents noted that ORRV use conflicts with forestry management programs were as frequent as those with cross-country military vehicle use. In fact, ORRV use conflicts with fish and wildlife management programs were second only to those created by heavy weapons use. A few respondents indicated that ORRV use conflicted with the policies and goals of hunting and fishing programs, grazing outleases, and rare and endangered species conservation.

Although the results of this survey were somewhat subjective, it showed a need for proper ORRV planning. Proper planning, or at least the use of a systematic approach, will help minimize resource impact. If this planning becomes a part of an integrated resource management approach, some of the resource conflicts will be resolved.

Planning Goals and Objectives

The development of installation-specific statements of ORRV planning goals will depend on many installation-specific policies and conditions. However, a focus for goal development can be established, based on the required scope of outdoor recreation planning and the potential for resource conflict resolution. This focus will be the development of recreational opportunities, while giving due consideration to natural and integrated resource management.

Objective statements should relate directly to desired user experiences and resource suitability and capability. User preferences are identified through formal or informal user surveys. These surveys should yield information about the vehicle types and uses which require planning. Resource suitability and capability can be identified by several interrelated evaluation procedures. The use of surveys and resource evaluation procedures is addressed on pp 22-23.

Vehicle Uses

To develop ORRV use objectives and plans effectively, the planner must understand the activities that are part of the ORRV recreation experience. For off-road motorcycles, these activities have been identified by terms such as play, pseudo-competition, structured competition, and recreational trail riding.[15] Expanded definitions of off-road motorcycle activities relate to the rider's use of the machine. The rider may be:

1. A person who is learning to operate the vehicle.

[15] Garrell E. Nicholes, "A Foundation for Problem Solutions," Off-Road Vehicle Use: A Management Challenge, Richard N. L. Andrews and Paul F. Nowak, eds. (University of Michigan Extension Service, 1980), p 105.

2. One who is engaged in a play or unstructured competition experience in which the rider uses the machine to produce the recreation.

3. One who is involved in a structured competition which enables the rider, after mastering the physical and mental requirements of the sport, to be totally committed to the activity for some tangible or intangible reward.

4. One who uses the vehicle as a tool of transportation to participate in multidimensional activities such as camping, picnicking, fishing, photography, cultural sightseeing, riding for pleasure, and many more opportunities.[16]

These definitions generally can apply to most other types of ORRVs. For example, four-wheel-drive (4WD) vehicles are most often used for transportation to remote outdoor recreation sites (e.g., hunting and fishing areas). However, a popular 4WD activity is the mud derby. Mud derbies are generally held on a closed course designed to test the driver's and the machine's ability to negotiate deep mud. This might be considered competition or pseudo-competition, depending on prizes and awards and the intensity of competition.

Snowmobiles also have a variety of uses. Most snowmobile activity is in the form of play or unstructured competition. The rider uses the vehicle primarily to get outdoors during the winter. The desired recreational experience is achieved through actual use of the vehicle, either cross-country or on established trails. Although this is the most common use of the vehicle, several snowmobile races are held annually, and most snowmobile clubs organize at least one lengthy trip per year.

These different possible ORRV uses should be considered early in the planning process. Although it may not be possible to provide areas for each type of use, it is inappropriate either to plan for a use that is not in demand or not to consider a use that is in demand. An example of an inappropriate plan is one that only provides an area for riders to learn to operate an ORRV (i.e., a novice area). Novice areas are generally open and contain little, if any, challenging terrain. In most cases, users will soon want to try a more challenging area. If such areas are not provided, unauthorized use of more challenging terrain can become a problem.

Most installations will not have enough land to provide large areas for general cross-country ORRV movement. However, many can provide novice areas and closed course areas for various types of ORRV competition. Many installations will have land available for and suitable to trails. Trails can either be developed within a designated area of appropriate size or established to connect with existing trails outside the installation. The latter type is especially suitable where state or regional snowmobile trail systems have been developed.

Regardless of the trail's ultimate use, it should be responsive to user demands and preferences. Demand and preference information can be determined from survey data taken from the Quarterly Sample Surveys of Military Personnel

[16]Garrell E. Nicholes, "Trailbiking Today," Planning for Trailbike Recreation, Part II (U.S. Department of the Interior, Heritage Conservation and Recreation Service, March 1981), p 16.

(QSSMP) and the installation's Morale Support Activity (MSA) surveys.[17] QSSMP surveys should provide general information about recreation demand. MSA surveys are the best sources of installation-specific information and could be structured to provide detailed data about ORRV use and preferences. Survey data from other Federal, State, and local agencies can also provide useful information, especially about civilian demand.

Interface With Outdoor Recreation Planning

The information in this report provides a fairly comprehensive ORRV use planning process; however, the process should be interfaced with the total outdoor recreation planning process. This will enhance the viability of decisions related to the establishment of ORRV areas and improve overall development of the installation's outdoor recreation program.

CERL Technical Report N-124, Application of the Recreation Opportunity Spectrum for Outdoor Recreation Planning on Army Installations, describes an overall planning framework for developing installation Outdoor Recreation Plans.[18] The planning framework is based on the Recreation Opportunity Spectrum (ROS) concept. The ROS is a continuum of possible combinations of recreation activities, settings, and experiences. The ORRV planning process described here is easily incorporated into the ROS planning framework.

Briefly, ROS planning provides an approach for resources inventory, specifying recreation opportunities, resource capability and suitability analysis, selection of management objectives and practices, and impact assessment. The ROS approach analyzes a variety of installation-specific physical, social, and managerial conditions. This approach, together with the methods used for resources inventory and for capability and suitability analysis, can support integrated resource management.

Incorporating ORRV planning into the ROS planning approach has other benefits. One is the development of ORRV use objectives, which are more easily developed once overall outdoor recreation objectives are defined. Another benefit is the selection of candidate use areas (see Chapter 3).

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[17] Welfare, Recreation, and Morale -- Army Morale Support Activities, AR 28-1 (Department of the Army, 1 January 1979), p 1-9.

[18] R. M. Lacey and W. D. Severinghaus, Application of the Recreation Opportunity Spectrum for Outdoor Recreation Planning on Army Installations, Technical Report N-124/ADA114892 (CERL, 1982).

3 PLANNING FOR NONCOMPETITIVE ORRV USE

Introduction

Once planning goals and objectives are tentatively identified, components 3, 4, 5, and 6 of the general planning framework (see p 10) can be addressed. The tasks implied by components 3 and 4 represent the technical base of the general planning process. The results of these tasks are used in the decision-making and plan development tasks implied by components 5 and 6.

In the general planning process, the data collection and evaluation and the decision-making tasks are within four components; however, for noncompetitive ORRV use planning, it might be more appropriate to combine them under three major tasks: candidate area selection, environmental evaluation, and area development. Each task requires collection and evaluation of different information and represents a different decision point.

This chapter describes the process and procedures for collecting data and arriving at the three decision points. It also suggests special conditions that should be considered when completing the process for distinct types of vehicles.

Major Planning Tasks

Each major noncompetitive ORRV planning task involves analyzing different information. Candidate area selection involves consideration of the installation's other missions and land use elements. Environmental evaluation involves analyzing candidate areas in detail to determine environmental and natural resource suitability. Area development involves analyzing alternative areas using standard trail development criteria to produce the best possible ORRV use opportunity.

Candidate Area Selection

Two conditions can be used to address candidate area selection. The choice depends on the status and comprehensiveness of the installation's existing outdoor recreation plan.

Condition 2 — An Up-to-Date Plan Is Available. If an up-to-date, comprehensive plan is available, candidate area selection should be easy; i.e., the plan should already address potential land allocation for ORRV use. For example, consider the planning approach used when applying the ROS concept to installation outdoor recreation planning.*

The ROS concept considers motorized recreation as a major recreation experience or opportunity class. Once the ROS planning approach is applied and recreation and integrated resource suitability analysis is performed, the

* For detailed information on the ROS concept and its use in installation outdoor recreation planning, see R. M. Lacey and W. D. Severinghaus, Application of the Recreation Opportunity Spectrum for Outdoor Recreation Planning on Army Installations, Technical Report N-124 (CERL, 1982).

land and water resources that can be allocated to motorized recreation will have been identified. The allocated area is shown on a map, and candidate ORRV use areas can then be selected from this map.

If an approach other than the ROS concept was used to develop the installation outdoor recreation plan, the user should still be able to select candidate areas from the plan map. However, the user should insure that the plan and plan map consider ORRV use a possibility for the use of installation lands. If this is not the case, the steps leading to candidate area selection should follow those summarized below.*

Condition 2 — A Comprehensive Plan Is Not Available. If an up-to-date, comprehensive plan is not available, the first step in selecting candidate areas is to examine current installation and adjacent land use. This will identify land use that would be sensitive to or incompatible with ORRV use. Major information sources include the Installation Master Plan, Land Management Plan, Endangered Species Inventory, Historic/Archaeologic Resources Management Program, and the Office of the Director of Plans and Training. However, these sources are not exclusive; any source which can identify potentially incompatible, sensitive, fragile, and unique land uses or areas should be consulted.

A primary consideration is that lands under Army control were acquired for National Defense purposes; any other uses are secondary to the installation's mission. Therefore, lands needed to meet mission requirements should not be considered as candidate use areas. Additional land use categories which should not be considered are specifically identified in AR 210-9; others are generally known to conflict with ORRV use. Four of these have been identified:

1. Areas where ORRV use would adversely affect the installation's mission, security, and operation (e.g, explosive ordnance storage, impact areas, and drop zones).

2. Areas which cannot be used because of existing land use (e.g., housing areas and noise-sensitive outdoor recreation areas).

3. Areas where the operation of ORRVs would be unsafe for participants and nonparticipants (e.g., abandoned ordnance impact areas, trails set aside for horseback riding, and active hunting areas).

4. Areas which have been identified as, or are suspected to be historically/archaeologically significant, critical wildlife habitat, critical natural resource areas, etc.

Table 1 lists several potentially sensitive and incompatible land uses, and possible conflicts which should be considered when identifying them. Table 1 is not all-inclusive; any land use which uniformly exhibits or could be affected by one or more of the conflict conditions should not be considered.

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* These steps are described in detail in CERL Technical Reports N-86, N-105, and N-110.

Table 1

Land Uses and Areas Which Are Incompatible With ORRV Use

Examples of Land Uses Which Conflict With ORRV Use (By Category of Conflict)	Conditions Which Place Land Uses in Conflict

Safety and Security of Military Function

Land Uses	Conflict Conditions
• Active bivouac areas	• Live fire
• Active nonmechanized training areas	• National security
• Active maneuver areas	• Personal safety of Army personnel
• Airfield aprons & approach zones	• Physical security of personal property
• Demolition areas	• Quantity-distance limits
• Explosives storage	• Unexploded ordnance
• Impact areas	• Tactical vehicle operations
• Motor pools	

Incompatible Land Uses

Land Uses	Conflict Conditions
• Administrative areas	• Aesthetics
• Agriculture/grazing outleases	• Dust
• Campgrounds	• Encroachment
• Churches	• Noise
• Family housing	• Personal safety of personnel
• Hospitals	• Property security
• Industrial sites	• Traffic congestion
• Libraries	• Vandalism
• Outdoor theaters	• Vehicle operation
• Schools (military and dependent)	
• Troop Housing	

Table 1 (Cont'd)

Examples of Land Uses Which Conflict With ORRV Use (By Category of Conflict)	Conditions Which Place Land Uses in Conflict

Participant & Nonparticipant Safety

Land Uses	Conflict Conditions
• Active hunting areas	• Live fire
• Active landfills	• *Loose surface material*
• Active quarries & mines	• Moving tactical vehicles
• Active training areas	• Noise
• Demolition areas	• Personal safety
• Explosives storage	• Recreation conflict
• Frozen water bodies	• Steep slopes
• Hiking trails	• Thin ice
• Horse (bridle) trails	• Unexpected animal actions
• Impact areas	• Unexploded ordnance
• Passive outdoor recreation	• Water quality
• Potable water storage	
• Ranges	

Natural and Other Resource Locations

Land Uses	Conflict Conditions
• Archaeological sites	• Aesthetics
• Breeding, migration, or nesting areas	• Animal harassment
• Cemeteries	• Dust
• Food plots and feeding area	• Encroachment
• Historic sites and structures	• Human presence and disruption
• Paleontologic sites	• Noise
• Petroglyphs	• Poaching
• Rare, endangered, or threatened plants, animals, and fish	• Petroleum spills
• *Timber plantations*	• Siltation
• Wetlands	• Soil compaction
	• Soil erosion
	• Turbidity
	• Vandalism
	• Vegetation damage

Once all sensitive and incompatible land uses and areas have been identified, they should be marked on an installation map. (Figure 1 is a simplified example.) This map is used as a working base map for other parts of the selection procedure.

Noise Considerations. The next step is identifying particularly noise-sensitive land uses such as hospitals or off-post nursing homes, and establishing noise buffer zones. To establish these zones, at least three types of information are required:

1. The maximum acceptable sound-level requirements for land uses considered to be noise-sensitive. (See Table A1 in Appendix A.)

2. The estimated average sound level (in A-weighted decibels [dBA]) generated by the ORRVs expected to use a proposed area. (See Table 2.)

3. The estimated demand for the proposed ORRV area (i.e., the number of vehicles expected to be operated in the area).

This information is used to determine Distances Necessary for Noise Attenuation (DNNAs). Appendix A describes, step by step, how to calculate DNNAs; the example given applies to 4WD vehicle trails but could be adapted to other types. DNNAs are distances that a proposed ORRV use area should be located from noise-sensitive land uses in order to meet maximum acceptable noise-level requirements. After determining the DNNAs for each noise-sensitive land use, noise buffer zones can be marked on an appropriate base map (see Appendix A).

Site and Terrain Conditions. The base map and topographic maps can be used to decide which areas would be most suitable for ORRV use. User input should also be gathered to determine site preferences (e.g., steep slopes, water crossings, and/or muddy areas).

The major factors which must be considered are acreage, site requirements, and terrain characteristics. The minimum size for an ORRV use area is about 5 ha, while the maximum size can reach 800 ha; however, it appears that no more than 50 to 100 ha can be safely maintained and policed by most installations. The necessary acreage will depend mainly on the intensity of user demand, type of terrain, the available land area, and the ability of the sponsoring agency to provide maintenance and supervision for the area.

Candidate areas should be easy to reach by road in order to eliminate cross-country travel to the site. If trail, rather than cross-country use is preferred, an existing trail system should be selected; for example, fire breaks or an unpaved road system could be closed to general traffic. Snowmobile trails in particular should be located on an existing trail system, such as trailbike trails, bridle trails, and road systems not used during the winter.*

Generally, slopes for trail development should not exceed 30 percent. Trails should not be developed in areas which contain several streams, streams

* CERL Technical Report N-105 provides further discussion on snowmobile trail site requirements.

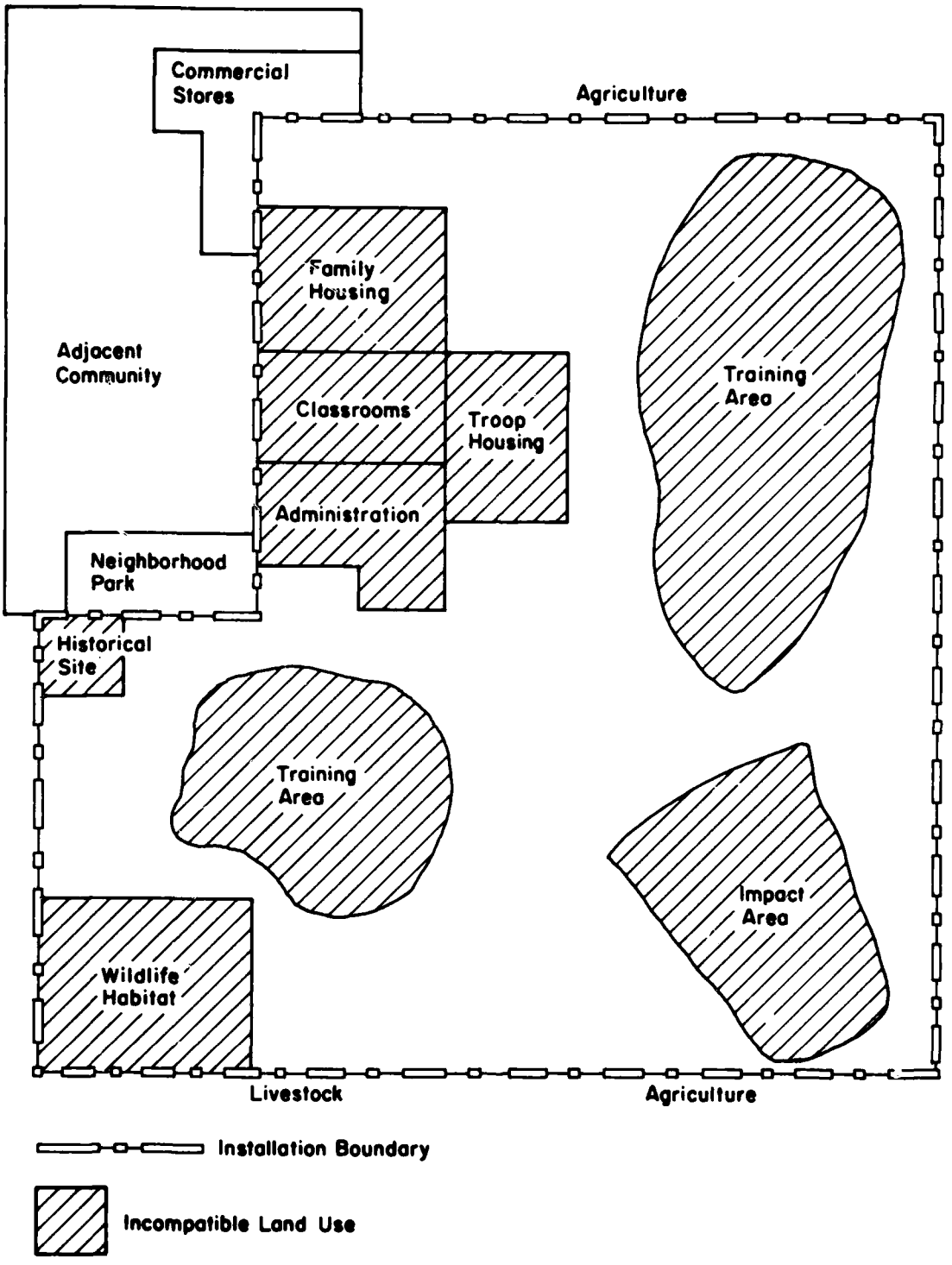

Figure 1. Base map identification of incompatible land uses.

Table 2

Noise Levels dBA Generated by ORRVs at 15.24 m (50 ft)*

Trailbikes	
Dual purpose	83
Off highway enduro models	86
Motocross	120
Snowmobiles	
Traveling 15 mph	73
Full throttle	78
Older models/modified machines	120
4WD Vehicles	
Light trucks/ATVs	
Non-defective mufflers	76
Defective or modified mufflers	80

*Noise levels generated by these vehicles vary depending on (1) the type of vehicle, (2) whether (and how) the user has modified the vehicle, (3) the mode of operation. These levels are only provided as general guidance.

(From R. M. Lacey, et al., Evaluation of Lands for Off-Road Recreational Motorcycle Use, Vol 1; Evaluation Method, Technical Report N-86/ADA096528 (CERL, 1980); R. M. Lacey, et al., Evaluation of Lands for Recreational Snowmobile Use, Technical Report N-105/ADA101075 (CERL, 1981); R. M. Lacey and W. D. Severinghaus, Evaluation of Lands for Off-Road Recreational Four-Wheeled Drive Vehicle Use, Technical Report N-110 (CERL, 1981).

with steep banks, cliffs, and/or deep gullies. Areas which will require the least amount of site preparation (e.g., clearing) should receive first consideration. Selecting areas which provide scenic views will give the users incentives for remaining on the trails.

Areas where the water table depth is less than 1.2 m should be avoided.* Required snow conditions for snowmobile trail development are discussed on p 28.

Environmental Evaluation

Soil Factors. Once candidate areas or corridors have been chosen, the soil suitability must be analyzed. A soil limitations map should be developed for this purpose; this requires a recent soil survey of the candidate area and a limitations rating for each soil found there.

Soil Surveys. Seventy percent of active Army installations are located in areas at least partially covered by a U.S. Department of Agriculture Soil Conservation Service (SCS) soil survey. These surveys are available from the state and local SCS offices.

Limitations Ratings. The SCS, in cooperation with CERL, has developed special soils rating criteria to evaluate soil suitability for trailbike and 4WD vehicle use. Appendix B lists these criteria and describes the soil limitations ratings in detail.

Limitations Map. To prepare the limitations map, the soil series map(s) in the soil survey which corresponds to the candidate area(s) should be reproduced. This map will show the boundaries of each soil series or phase. The limitations map is prepared by coloring the soil series phases or map units within their respective boundaries. (Appendix B provides more information for determining the limitations rating for a particular soil phase.) Soils with slight, moderate, and severe limitations are each given a different color. Based on this map, candidate areas or portions of candidate areas can be eliminated from consideration.

Alternative Input. If the soils of a candidate area have never been surveyed or if available survey data is out of date, a different procedure is followed. More technical soils analysis and rating procedures which have been developed to supplement the ORRV evaluation procedures must be used.

Based on the soil limitations, candidate areas or portions of candidate areas can be eliminated from consideration. Generally, those which are eliminated contain soils with severe limitations. However, certain areas where soils have moderate or even severe limitations may be considered if proper maintenance or mitigation procedures can balance the effect of the restrictive features (e.g., construction of runoff control terraces to reduce erosion).

Biological Factors. AR 210-9 requires that the value of the biological resources in potential ORRV areas be examined and assessed. If possible, the examination should consider the possible impact of ORRV use on these resources.

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* CERL Technical Report N-110 provides water table/drainage criteria.

Site Visit. A professional biologist with field qualifications should field check each candidate area or corridor. If a biologist is not assigned to the installation, the U.S. Fish and Wildlife Service (USFWS) should be consulted.

Endangered Species. Any candidate area which contains a rare, endangered, or threatened plant species (as defined by Federal or State law), or locally important plant and animal populations (i.e., remnant prairie lands) should not be considered. No area containing a rare, endangered, or threatened animal species at any time should be opened to ORRV use until a site visit by USFWS has confirmed that the species will not be adversely affected.

Biological Rating. After thoroughly examining each alternative, the biologist should rank areas or corridors according to their acceptability for use. The biologist must consider factors such as habitat destruction, noise disturbances, and mechanical injury to plants.

Appendix C describes a system for rating biological resources. The biologist can use this system in two ways. The first has the biologist determine the "relative value" of the biological resources in each corridor by comparing the area's resources with those of the rest of the installation. The second method has the biologist predict an area's susceptibility to ORRV damage.

Public Involvement. Before the ORRV use area is finally established, the planner should solicit ideas and suggestions from the public.* Through informal workshops and meetings, both during the initial planning and when candidate sites have been selected, the public can make constructive comments before any firm decisions are made. A site can be chosen once an environmental evaluation is completed and information from users and the public sector is obtained.

Environmental Assessment. Due to the controversial nature of ORRV operations, an environmental impact assessment or statement must be prepared before areas or trails are opened to vehicles. Much of the information obtained from the evaluation procedures should be used to prepare these documents.

Area Development

Once the areas have been selected, trail development can begin. It is emphasized that trail development should insure the safety of vehicle operators. Thus, regular inspection of trails by qualified safety personnel is recommended.

Table 3 summarizes the criteria used to develop a trail for trailbikes, snowmobiles, and 4WD vehicles. The parameters include trail length, width, slope, surface materials, clearances, turns, water hazards, vistas, turnouts, and signing.

Operating Conditions. The installation's commanding officer has authority, through AR 210-9, to allow a variety of activities at his/her discretion.

* CERL Technical Report N-105, pp 23 and 24, provides guidance about the concept of public involvement.

Table 3

Trail Development Criteria

	Trailbikes	Snowmobiles	4WD
Length	200 m minimum 3 km maximum	6.5 km minimum To handle 80 vehicles per each 8 km	6.4 km minimum
Width	0.6 m to 2 m	3 m one-way traffic 5 m two-way traffic	1.8 m to 3 m one-way traffic 3.75 to 5 m two-way traffic
Slope	25% climb 40% climb experienced riders 15% for lateral slopes - beginners 30% for lateral slopes - experienced riders	25% climb - maximum	15 to 20% climb
Surfaces	Natural soils Crushed rock for improved surface	Leveled ground 5-in. snowcover 3 in. compacted snow	Natural soils Crushed rock 10 to 40 mm for improved surface Bumps to control vehicle speed
Turns	Turn radii 2 to 10 m Turns of > and < 90° No straights > 100 m	Gradual Trail curve radius > 7.5 m No banked curves	Varied turns of > and < 90° No straights > 100 m No steep banked curves
Clearances	Lateral clearance - 0.6 m from edge Vertical clearance - 2.25 m	Lateral clearance - 0.3 m from edge Vertical clearance - 2.5 m	Lateral clearance - 0.3 m from edge Vertical clearance - 3m
Water Hazards	Reinforced-surface fords, culverts, or bridges should be built Artificially channelled runoff water if added water features desired	Culverts or bridges should be built	Reinforced-surface fords, culverts, or bridges should be built Artificially channelled runoff water if added water features desired
Vistas	Scenic and rest areas	Scenic and rest areas	Scenic and rest areas
Turnouts/ Spurs	Provide access to scenic and rest areas	Provide access to scenic and rest areas	Provide access to scenic and rest areas
Signing	Regulatory, trail markers, and informational Per Federal and state requirements for roads and highways	Regulatory, trail markers, and informational Consult appendix in CERL Technical Report N-105*	Regulatory, trail markers, and informational Per Federal and state requirements for roads and highways

(From R. M. Lacey, et al., Evaluation of Lands for Off-Road Recreational Motorcycle Use, Vol 1: Evaluation Method, Technical Report N-86/ADA096528 (CERL, 1980); R. M. Lacey, et al., Evaluation of Lands for Recreational Snowmobile Use, Technical Report N-105/ADA101075 (CERL, 1981); R. M. Lacey and W. D. Severinghaus, Evaluation of Lands for Off-Road Recreational Four-Wheeled Drive Vehicle Use, Technical Report N-110 (CERL, 1981).

It is recommended that all vehicles operated by military personnel and/or their dependents be inspected by the Provost Marshall for compliance with all applicable safety regulations. Table 4 lists minimum equipment requirements for trailbikes, snowmobiles, and 4WD vehicles.

ORRV passenger limits vary; for example, no passengers can be carried on trailbikes. For snowmobiles and 4WD vehicles, the number of passengers must not exceed the recommended industry capacity for the particular vehicle. The number of passengers carried by 4WD vehicles should not exceed the number of functional seat belts.

CERL Technical Reports N-86, N-105, and N-110[19] contain further information on operating conditions for different types of ORRVs. The topics covered include hours of operation, rules of the road, direction of traffic, and roadway operation.

Considerations for Specific Vehicle Types

The various types of ORRVs were designed for different purposes and for travel across different surfaces. Therefore, flexible techniques are needed to evaluate areas where ORRVs might be used.

Table 4

Minimum Equipment Requirements

	Trailbikes	Snowmobiles	4WD
Lights	Headlights and taillights for street use (No trail use allowed during evening hours)	Headlights and taillights for nighttime operation and during poor visibility conditions	Headlights and taillights for nighttime operation and during poor visibility conditions
Seatbelts	NA	NA	For each passenger and driver
Muffler	Factory equivalent; spark arresting	Factory equivalent	Factory equivalent
Roll Bar	NA	NA	Permanently attached to vehicle

[19] R. M. Lacey, H. E. Balbach, and R. S. Baran, Evaluation of Areas for Off-Road Recreational Motorcycle Use, Vol I: Evaluation Method, Technical Report N-86/ADA096528 (CERL, 1980); R. M. Lacey, et al., Evaluation of Lands for Recreational Snowmobile Use, Technical Report N-105/ADA101075 (CERL, 1981); and R. M. Lacey and W. D. Severinghaus, Evaluation of Lands for Off-Road Recreational Four-Wheel Drive Vehicle Use, Technical Report N-110 (CERL, 1981).

In addition to the differences in trail development criteria and vehicle equipment listed in Tables 3 and 4, other factors should be considered for trailbikes, 4WD vehicles, snowmobiles, and other types of ORRVs. Following this guidance will increase safety and reduce environmental impact.

Trailbikes

Trail length for trailbikes should not exceed 100 m for long straightaways because these vehicles can reach such high speeds that the driver may lose control. Natural obstructions such as boulders can be used around turns to prevent trailbikers from shortcutting.

It is recommended that trails be developed which will traverse slopes laterally rather than climbing them vertically. Trails should not laterally cross slopes of more than 15 percent for beginners or 30 percent for more experienced riders.

4WD Vehicles

The basic differences between 4WD vehicles and trailbikes are that 4WD vehicles are larger and heavier and have four wheels touching the ground. In addition, 4WD vehicles are generally operated at a much lower average speed. These differences make 4WD vehicles more stable, but also make them more likely to become stuck and to damage soil surfaces. These differences increase or decrease the severity of limitation for 4WD vehicle use as compared to trailbike use, depending on what factor is being considered.

Soils. Recreational 4WD vehicles are more likely than trailbikes to be able to travel over surfaces with many large stones (i.e., stones greater than 76 mm, but less than 250 mm in length or width). If the surface coverage of large stones or boulders is greater than 35 percent, the soil has severe limitations for 4WD vehicle use. Coverage of less than 35 percent results in only slight or moderate limitations.

Soils rated as having moderate or severe limitations for trailbike use due to wetness or sandy conditions will also have severe limitations for 4WD vehicle use. Soils with a seasonally high water table at a depth of 0.6 to 1.2 m will have moderate limitations for 4WD vehicle use due to wetness; soils with a water table deeper than 1.2 m will have slight limitations.

For 4WD vehicles, slopes have moderate limitations if they are between 15 and 35 percent and severe limitations if they are greater than 35 percent. The degree of slope for a particular soil can generally be determined from the soil survey description. It can also be identified from either topographic maps or a field survey.

Soils subject to frequent flooding (more often than once in 2 years) have moderate limitations for trailbike use but severe limitations for 4WD vehicle use. Soils subject to occasional flooding (less often than once in 2 years, but likely under normal conditions) have slight limitations for trailbike use but moderate limitations for 4WD vehicle use. The probability of flooding can generally be identified from the soil survey description.

Simple procedures for analyzing surface coverage of large stones, depth to water table, slope, etc. are described in a supplement to Volume II of CERL Technical Report N-86. This supplement is available from the MACOM natural resource offices or the National Technical Information Service, Springfield, VA.

Wildlife and Vegetation. Recreational 4WD vehicle use is somewhat unique because it can be done all year. Therefore, special seasonal conditions related to wildlife and vegetation apply for determining incompatible land uses and areas. Qualified biologists and foresters should be consulted for this project.

During the winter, lack of food generally weakens wildlife. If animal activity increases because of the presence of people and machines, this condition can be compounded and cause death from exhaustion or exposure. The wintering condition of animals in candidate areas should be examined before an area or trail is opened for winter use. Special attention should be given to identifying -- and eliminating from consideration for trail development -- areas where wildlife concentrate and feed during winter months (e.g., deer yards).

When 4WD vehicles run over plants or compact the snow too firmly, the early spring growth of vegetation can be affected. Thus, special consideration should be given to prohibiting 4WD operation where predominant vegetation is being managed for commercial or other use (e.g., winter wheat or alfalfa fields, timber plantations, and grassland preserves).

Snowmobiles

Site Selection. Areas where snowmobiles may be operated may include some "restricted" terrain or land use. However, many factors, such as frozen bodies of water, that restrict development of areas for snowmobile use will be desired by some users. Therefore, if possible, the site selected should provide an area that will be used voluntarily by most snowmobile operators.

Rolling topography interrupted by wide floodplain areas should receive primary consideration. Slopes for trail development should not exceed 30 percent.

There are few limits on the types of suitable vegetation in candidate areas, except for places identified as incompatible because of commercial use or environmental sensitivity. However, immature trees can be damaged by snowmobile use, and a significant number of stumps in a candidate area can present a safety hazard. Planting or harvesting areas should also be avoided.

It is recommended that areas with extremely rocky soil surfaces or wetlands be avoided. Rocky surfaces are avoided for user safety. Certain wetland soils, even when snow-covered, cannot support snowmobile traffic and are therefore avoided for environmental reasons; snowmobile use could affect the area's delicate biological balance.

Trail Development. Trail length will vary greatly, depending on available acreage and system design. According to Bombardier Limited, a leading manufacturer of snowmobiles and trail maintenance equipment, a well-designed

trail can handle 80 snowmobiles for each 8 km (5 mi) of trail.[20] For safety, trail width through turns should be larger than on straightaways.

For safety reasons, trails normally should not cross slopes laterally; however, if this is necessary, the trail should be cut and filled to provide a level operating surface. Precautionary erosion control measures should be taken for summer months. TM 5-630 provides initial guidance on possible erosion control measures.[21]

Trail curves should be as gradual as possible. Banked curves should be avoided because they may encourage high speed and unwarranted operator confidence. Before snow cover, trail surfaces should be made as level as possible through grading and cut and fill operations; however, care should be taken to ensure proper erosion control measures (see TM 5-630).

Snowmobiles should not be used on installation lands until the snow is 130 mm (5 in.) deep on the trail. Once snowmobile use has compacted the snow, a minimum depth of 75 mm (3 in.) of compacted snow is recommended for continued trail use. All trails with exposed soil must either be closed at once, or the bare spots replenished with snow. Extensive replacement of snow is not normally warranted.

All vehicles operated by military personnel or their dependents should be inspected for compliance with all applicable safety regulations. Before being operated onpost, vehicles operated by unsponsored civilians residing offpost should be licensed, registered, or inspected as necessary to meet State and local requirements. If applicable to State requirements, all operators should be licensed or registered as snowmobile operators in the state or in their state of residence. Operators 10 to 16 years of age may operate a complying vehicle while directly supervised by a parent or legal guardian who is also operating a complying vehicle.

Passengers may be carried on a snowmobile if they do not exceed the particular vehicle's recommended capacity; however, a maximum of three persons per vehicle is recommended. Trailing sleds for passengers or cargo may be allowed; a maximum of one per vehicle is recommended.

All vehicles operated after dark must have functioning headlights and taillights. These lights must be used if snowmobiles run on or next to roadways, or on trails designated for two-way use. Vehicles may be operated along one-way trails at night without headlights in operation; many users prefer this type of operation. If nighttime operation is not allowed, snowmobiles should not use the trail between 15 minutes after sunset and 15 minutes before sunrise. To avoid disturbing nonparticipants during normal sleeping hours, no operation should be allowed between 2300 and 0700 hours, regardless of the time of sunrise and sunset.

Wildlife and Vegetation. Snowmobiles, like 4WD vehicles, operate during the winter and therefore have a similar impact on the wildlife and vegetation

[20] Bombardier Limited, A Guide to the Development and Maintenance of Good Snowmobile Trails (Bombardier Limited, Valcourt, Quebec, Canada, 1972).

[21] Repairs and Utilities: Ground Maintenance and Land Management, Technical Manual (TM) 5-630 (Department of the Army, 4 December 1967).

of a snow-covered area. Thus, the previous section on 4WD impacts to wildlife and vegetation (p 27) would also apply here.

Other Vehicles -- Dune Buggies, All Terrain Vehicles, Swamp Buggies

Site Selection. The major considerations in choosing a trail site for dune buggies, all-terrain vehicles (ATVs), and swamp buggies depend on soil and terrain conditions and the area's biological limitations. Selection of candidate areas for all these vehicles should insure that damage to local vegetation and wildlife is minimal.

Because dune buggies are normally driven in sand dune areas, they can cause a serious soil erosion problem when driven over dunes that have been stabilized by vegetation. Once this vegetation is crushed or uprooted, wind and water erosion will greatly increase and eventually destroy the dunes.

Relatively flat sandy beaches are the most appropriate areas for dune buggy trails since they would incur the least impact. Areas with sand dunes considered to be fragile ecosystems should not be considered for trail use. Susceptibility to impact can be determined by noting the density and diversity of annual vegetation, the existence of rare or threatened vegetation or wildlife, and the presence of burrows or other forms of wildlife habitat in the dune areas.

Because ATVs, swamp buggies, and other amphibious vehicles can travel over wet areas, their major impact is on the resident wildlife. They can also damage aquatic vegetation. Any swamplands, marshes, or other wetlands containing rare or endangered wildlife or vegetation should not be considered as an ORRV trail site. Rangelands having many grazing livestock are also not suitable for trail areas.

Trail Development. When developing trails for ATVs, dune buggies, swamp buggies, and other amphibious vehicles, the suggestions in Chapter 7 of CERL Technical Report N-110 should be consulted. Surface composition, soil drainage characteristics, and number of wet areas should also be examined.

Dune buggies are equipped to function in sandy areas, so the surface material can be much finer than on ATV trail surfaces. ATV trails should be developed in areas that are dry enough to keep large tracks and ruts from forming. In many wet areas, long-range impacts can occur when the extreme weight of these vehicles compacts the soil. However, there are some areas where the climate and vegetation are more likely to induce rapid regeneration and obscure vehicle tracks, even though the areas may often be wet.

Maintenance and Monitoring of Trail Areas

Once areas and trails have been established, it will be necessary to provide appropriate trail maintenance and to monitor the environmental effects of ORRV operation. Areas and trails should be checked periodically to identify any maintenance problems, of which the most common is erosion. CERL Technical Reports N-86, N-105, or N-110 provide further guidance on trail maintenance.

Monitoring the environmental effects of ORRV use is critical because it forms the basis for changes in installation ORRV policy. Paragraph 6f of AR 210-9 should be consulted for developing appropriate procedures to monitor the effects of ORRV use. Appendix D outlines a method of monitoring impacts on soil, vegetation, wildlife, and on various human activities.

4 PLANNING CONSIDERATIONS FOR COMPETITIVE EVENTS

Introduction

The increased popularity of off-road vehicles has created a demand for areas where they can be used. Many military installations have responded to these demands by hosting competitive events. An informal CERL survey of major CONUS installations has identified common problems, misconceptions, and issues associated with competitive events. Current Army regulations related to recreational vehicles do not adequately address the unique challenges that organized competition presents to the installation. On-post coordination often neglects important considerations. The magnitude of these events and their impact on the environment is often underestimated, and the ability of the installation to support them is often misunderstood.

Background

Executive Orders 11644 and 11989[22] require managers of Federal government property to evaluate whether their facilities are suitable for ORRV use. In response to these Executive Orders, a preliminary version of Army Regulation 210-9[23] was issued in 1975 and a final version in 1977. Both the Executive Orders and the two versions of AR 210-9 imply that off-road vehicle use is loosely organized, family-oriented recreation whose primary purpose is to allow the participants to see and enjoy the outdoors. Subsequent events have shown that this is not always how ORRV users view the opportunity for off-road vehicle operation.

Army Installation Survey

In 1980, CERL conducted an informal survey of CONUS installations. One objective of the survey was to find out what types of competitive events had been held on Army installations between 1970 and 1980, when these events were held and which installations had hosted these events. A second broad objective was to categorize the experiences of the installation personnel, especially Environmental Office and Natural Resource Management personnel, who had direct knowledge of, and in some cases responsibility for, these events. The survey also tried to define the problems faced by such host installations. Finally, results of the survey would help the Army prepare both short- and long-term guidance for installation environmental and resource management personnel; this guidance would help them cope more effectively with the unique problem of hosting a competitive off-road vehicle event.

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[22] Executive Order 11644, "Use of Off-Road Vehicles on Public Lands," Federal Register, Vol 37, No. 27 (8 February 1972), pp 2877-2878; and Executive Order 11989, "Off-Road Vehicles on Public Lands," Federal Register, Vol 42, No. 101 (24 May 1977), pp 26959-26960.

[23] Installations -- Use of Off-Road Vehicles on Army Lands, AR 210-9 (Department of the Army, 1 July 1978).

Approach

Personnel from the Natural Resource, Environmental Office, and Recreation Services offices on 33 CONUS installations representing the Training and Doctrine Command, the Forces Command, and the Materiel Development and Readiness Command were asked the following series of general questions:

Have you hosted any event?

What types of events were they?

How many competitors and spectators were involved?

What kinds of problems were encountered?

Results

Twelve of the 33 installations had hosted one or more events between 1970 and 1980. There were 56 competitive events during that time, representing local, regional, and national competition. The number of events increased rapidly between 1970 and 1975, with somewhat fewer events recorded between 1975 and 1980. All but one of these events involved motorcycles; the other event was for cross-country 4WD vehicles. The events were typically organized and run by an on-post accredited recreation club; relatively direct participation by installation employees was evident.

Level and Type of Competition. As shown in Table 5, the types of events varied. Motocross races and scrambles were by far the most common events and are represented every year. Other events may be considered occasional; for example, the single four-wheel drive event was the only one of its type. Table 6 indicates that competition was usually on a regional or national level. Only a few events consisted solely of local personnel or persons from

Table 5

Frequency of Competitive Events

Events	Years					Total
	70 - 72	72 - 74	74 - 76	76 - 78	78 - 80	
Motocross	1	3	4	7	6	21
Hare Scramble	1	2	2	2	4	11
Trials		1	1			2
Enduro		1	2	2	4	9
Smoke Run		1	1	1		3
Poker Rally	1	2	2	2	2	9
Rally - 4WD				1		1

Table 6

Level of Competition*

Events	Local	Statewide	Regional	National
Motocross	3		4	1
Hare Scramble	2		2	1
Trials				1
Enduro			2	2
Smoke Run				1
Poker Rally			1	1
Rally - 4WD				1

* When a similar event was held in more than one year, its level was recorded only once.

the immediate vicinity of the installation. Thus, it is clear that these events draw interested participants from some distance.

Sponsors. Table 7 indicates the relationship between the initiator, the official sponsor, and the actual operator of each event. The on-post recreation club is clearly the single largest participant in these events. Off-post recreation clubs were the prime party in a few cases. The post recreation services office participated heavily in only a few cases. A significant problem in sponsoring off-road events is that existing regulations do not make it clear whether off-post organizations can officially be given the responsibility for operating such events.

Size of Event. The number of competitors reported in these events was somewhat higher than expected. Thirty to 50 competitors were a typical number; however, nine events reported more than 100 competitors or active participants, and one event reported more than 1000 participants. One hundred to 250 spectators and crew were typical. Two events had 800 to more than 1000 spectators and crew, and one had more than 5000. The single 4WD cross-country vehicle rally was the only event with more than 1000 entrants and more than 5000 spectators.

General Problems

The largest single general problem reported was that the different offices on an installation involved in an ORRV event did not feel that coordination among different offices, even when it took place, truly solved the problems. The people concerned with running ORRV competitive events are recreation services personnel, the Provost Marshall, and personnel from

Table 7

Areas of Responsibility for Competitive Events*

	Initiated Event			Sponsored Event			Ran Event		
	On-Post Club	Off-Post Club	Post Rec. Services Office	On-Post Club	Off-Post Club	Post Rec. Services Office	On-Post Club	Off-Post Club	Post Rec. Services Office
Motocross	4	1	2	3	1	3	4	2	1
Hare Scramble	3	1		3	1	1	4	1	
Trials	1			1			1		
Enduro	2	1		2	1	1	3	1	
Smoke Run	1			1			1		
Poker Rally	2			2			2		
Rally-4WD		1			1			1	

* When a similar event was held in more than one year, its area of responsibility was recorded only once.

various Facility Engineer offices, such as Environmental, Land Management, Natural Resources, Forestry, and Wildlife. Many of these offices belong to different directorates, and complete cooperation and understanding among them is not always evident. Therefore, problems could have been expected.

Of the installations which followed specific guidelines when organizing their events, almost half used American Motorcyclist Association[24] guidelines. About one-third of the installations also consulted and applied their own installation regulations, and a little over one-fourth reported the guidance that they attempted to apply wasn't adequate for the specific event involved. Finally, about one-third of the installations reported that one or more events resulted in official complaints about some aspect of their operation, either from an on-post office or directorate or from off-post persons.

Specific Problem Areas

The specific problem areas examined in the survey were noise, soil, vegetation, wildlife, crowd control and traffic, parking, restrooms, food service, and camping. No particular problems were reported with the arrangements for parking, camping, restrooms, and food service, mainly because no official provision was made for having any of these services. Problems were reported at some locations with wildlife, noise, crowd control, vegetation, and soil. However, Figure 2 shows that the majority of problems are not overwhelming. For example, in the wildlife category, the damage range is from none to moderate, roughly what was expected; the noise category shows the same range and roughly the same expected degree of damage.

Soils, however, are a problem. Here, moderate and significant damage was reported 40 percent of the time, and the amount of damage was greater than predicted in about half those cases. This clearly is an area where greater care should be taken. There were a few instances when crowd control was a significant problem and greater than expected. Vegetation damage usually was about as expected; however, as shown in Figure 2e, there were several measurable cases in which it was not only significant, but greater than expected.

Issues Raised by Survey Respondents

Other problems that were reported were not included in the standardized questions, but were volunteered as personal observations. Although these are not quantified, they are reported because they represent problems that should be identified. The most common of these was the question of whose responsibility it was to clean up and repair damage. Several installations reported that the sponsoring organization was either disbanded or ceased to participate in this cleanup and repair activity immediately after the event. These personnel also noted that this is probably why fewer and fewer installations are hosting competitive events, especially those which have not held any previously.

Another unanticipated problem was that of damage to the environment by personnel who were setting out the course for the competitive event. The installations had originally planned for a 1-day event and a noise problem

[24] 1980 AMA Amateur and Semi-Professional Competition Rule Book (American Motorcyclist Association, 1980).

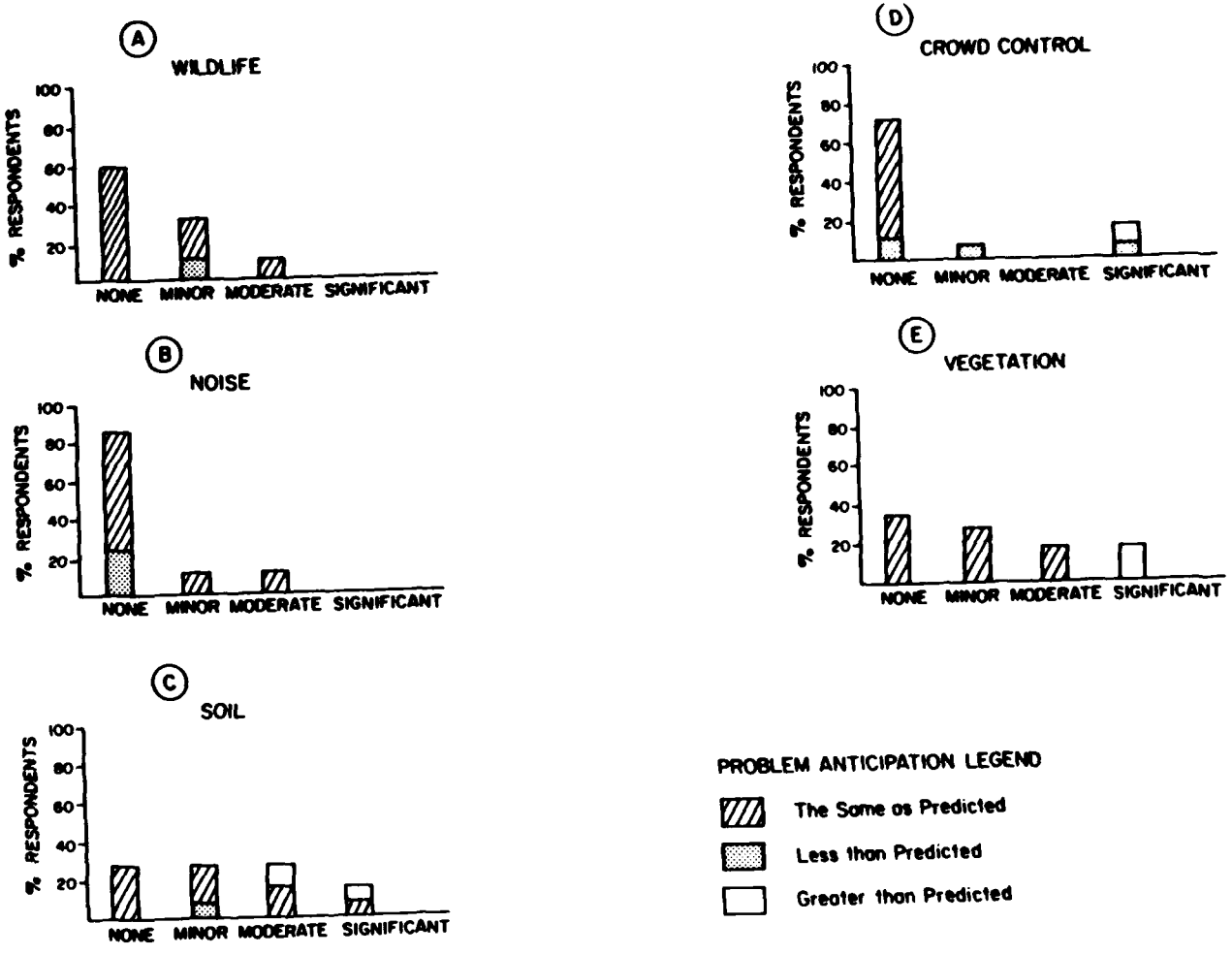

Figure 2. Problem areas resulting when competitive events are held.

lasting only 3 hours. However, the club that organized the event took 10 days to set up a trail; during that time, more than two dozen motorcycles operated by officials of the club used the trail for many hours over a week's time. The installation managers felt that more overall damage was done by the preliminary activities than by the actual event.

The third problem area was that DA, MACOM, and installation regulations have not clarified standard procedures for hosting a competitive event; i.e., they assume such events to be loosely organized family recreation. However, this is not the case because some of these competitive events have hosted more than 1000 persons.

Persons who volunteered information requested clarification of the following questions. First, to what degree can off-post persons (i.e., those with no military or civilian employment or dependent status), participate in the event, and also to what degree can organizations composed partly or wholly of such persons sponsor the event? Second, who is liable if a participant or a spectator is injured, and who is responsible for damages to property and to environmental resources in the area of use? Installation environmental and natural resources personnel are not sure who should provide and who should pay for the effort involved in repairing damages to vegetation, soils, and other installation environmental factors following an event.

Conclusions

The following conclusions were made from the informal survey. First, the number of events is still increasing, although more slowly than during the first 5 years after 1970. Second, problems caused by competitors and spectators are now a little easier for installation personnel to anticipate, and their ultimate severity is less often underestimated; however, in most events no specific provisions are made for dealing with crowds and visitors. Finally, specific environmental problems are relatively hard to predict; i.e., it can only be predicted that there will be some effects on soils, some on vegetation, and, although they are less easy to observe, some on wildlife. Also, the exact magnitude of these impacts is more often underestimated than overestimated.

Recommendations

Policy should be established which separates and specifies guidelines for dealing with competitive events, as opposed to guidelines for hosting loosely organized family recreation. For specific guidance on developing competitive trails and for setting up rules and regulations for these events, the American Motorcycling Association and the International Snowmobiling Industry Association should be consulted.

It is clear that careful selection of the areas where events will be held can minimize problems. Therefore, it is recommended that, at a minimum, the environmental guidance provided in the previous chapters be applied.

On-post coordination must be improved; it should start as early as possible and involve as many of the potentially affected offices and personnel as possible.

If competitive events are properly selected and coordinated and the location selected is appropriate, certain portions of many installations can definitely be used for ORRV activities.

5 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Planners and land managers can use the method described in this report to choose appropriate ORRV sites and to develop trails that will have a minimum impact on the area's environmental resources and on concurrent human activities. This information provides specific factors to consider for operating different types of ORRVs and for competitive and noncompetitive ORRV use. The public and ORRV users should have input into the decision-making process; this will alleviate many potential problems. When an area is opened to ORRV use, the effects of such use on the environment should be monitored.

Recommendations

1. Selecting an ORRV use area should be based on the appropriate environmental considerations (i.e., average noise level generated by the vehicles). An established area should be supervised to insure that use limits are not exceeded. Organized recreational activities involving ORRVs are within the scope of the Outdoor Recreational Program; therefore, supervision should be handled by Recreation Services personnel or by the military police, at the commanding officer's discretion.

2. An environmental assessment should be prepared before establishing an ORRV use area.

3. A trail area originally intended for individual recreational use should be evaluated further if its function is changed to support competitive events.

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APPENDIX A:

HOW TO DETERMINE THE DISTANCE NECESSARY FOR NOISE ATTENUATION (DNNA) WHEN ESTABLISHING FOUR-WHEEL DRIVE VEHICLE TRAILS

This appendix provides (1) a step-by-step example of how to calculate the Distance Necessary for Noise Attenuation (DNNA) or to establish use limits,* (2) a list of maximum equivalent sound level (Leq) requirements for selected land uses (Table A1), and (3) a listing of DNNAs which are already calculated for various noise requirement situations (Table A2). Figure A1 is a simplified example of a base map marked with noise-sensitive land uses and noise buffer zones.

Calculation Description and Examples

The DNNA is determined by the following equation:

$$DNNA = A \times 10^{\left[\frac{B + 10(\log C) - (D-5)^{**}}{20}\right]} \qquad \text{[Eq A1]}$$

where: DNNA = the Distance Necessary for Noise Attenuation.

A = The distance (feet or meters) from which sound-level measurements were taken to determine the average noise level of the 4WD vehicles which will use the area or trail.

B = The average noise level (in dBA) of the 4WD vehicles which will use the area or trail.

C = The estimated average daily use of the area or trail (projected demand). (Determined by projecting the maximum number of vehicles which will use the area or trail for each day of the week, adding these numbers, and dividing by seven.)

* Several considerations and techniques can be applied to determine the DNNA for ORRV use. The method described here was chosen for its simplicity; however, it yields very conservative results. If more detailed measures of DNNA are desired, the user may wish to use other methods. Two excellent sources are: (1) Environmental Protection: Planning in the Noise Environment, TM 5-803-2 (Departments of the Air Force, Army, and Navy, 15 June 1978); and Robin T. Harrison, Roger N. Clark, and George H. Stankey, Predicting the Impact of Noise on Recreationist: An Application of the Outdoor Recreation Opportunity Spectrum (U.S. Department of Agriculture, Forest Service, 1980).

**The term "D-5" in the argument of Eq A1 represents a 5-dB penalty in the Leq for land uses. This penalty is included as a precaution, because the sound of 4WD vehicles can be intrusive and annoying if their muffling systems are modified.

Table A1

Maximum Acceptable Equivalent Sound Level (L_{eq}) Requirements for Selected Land Uses*

Land Use	Maximum Acceptable Sound Level (in dBA)
Agricultural (except livestock)	80
Bachelor housing	65
Campgrounds and picnic areas (not associated with ORRVs)	65
Classrooms, libraries, and churches	65
Commercial and retail stores, exchanges, movie theaters, restaurants and cafeterias, banks, credit unions, enlisted officer clubs	70
Dental clinic, medical dispensaries	70
Family housing	65
Flight line operations, maintenance and training	80
Gymnasiums, indoor pools	70
Hospitals, medical facilities, Nursing homes (24-hr occupancy)	65
Industrial, manufacturing, and laboratories	70
Livestock farming, animal breeding	75
Neighborhood parks	70
Offices and administrative buildings -- military	70
Offices -- business and professional	70
Outdoor music shells, outdoor theater, and cultural events	55
Outdoor sports arenas, outdoor spectator sports	70
Playgrounds, active sport recreational areas	70
Transient lodging -- hotel, motel, etc.	65
Troop housing	65

*Adapted from Environmental Protection Planning in the Noise Environment, TM 5-803-2 (Departments of the Air Force, Army, and Navy, 15 June 1978).

Table A2

DNNA for Establishment of 4WD Use Areas
(Distance in Meters)

Maximum Acceptable Equivalent Sound Level (Leq) for Land Use (dBA)	Estimated Number of 4WD Vehicles Using the Area									Average Sound Level for 4WD Vehicles Using the Area (dBA at 15.24 m)
	5	10	15	20	25	30	40	50	60	
65	100	100	100	100	100	100	100	108	118	60 dBA
70	100	100	100	100	100	100	100	100	100	
75	100	100	100	100	100	100	100	100	100	
80	100	100	100	100	100	100	100	100	100	
65	100	100	100	100	100	105	121	136	149	62 dBA
70	100	100	100	100	100	100	100	100	100	
75	100	100	100	100	100	100	100	100	100	
80	100	100	100	100	100	100	100	100	100	
65	100	100	100	108	121	132	153	171	187	64 dBA
70	100	100	100	100	100	100	100	100	105	
75	100	100	100	100	100	100	100	100	100	
80	100	100	100	100	100	100	100	100	100	
65	100	100	118	136	152	167	192	215	236	66 dBA
70	100	100	100	100	100	100	108	121	133	
75	100	100	100	100	100	100	100	100	100	
80	100	100	100	100	100	100	100	100	100	
65	100	121	148	171	192	210	242	271	297	68 dBA
70	100	100	100	100	108	118	136	152	167	
75	100	100	100	100	100	100	100	100	100	
80	100	100	100	100	100	100	100	100	100	
65	108	152	187	216	241	264	305	341	373	70 dBA
70	100	100	105	121	136	149	172	192	210	
75	100	100	100	100	100	100	100	108	118	
80	100	100	100	100	100	100	100	100	100	

Table A2 (Cont'd)

Maximum Acceptable Equivalent Sound Level (Leq) for Land Use (dBA)	Estimated Number of 4WD Vehicles Using the Area									Average Sound Level for 4WD Vehicles Using the Area (dBA at 15.24 m)
	5	10	15	20	25	30	40	50	60	
65	136	192	235	271	303	332	384	429	470	72 dBA
70	100	108	132	153	171	187	216	241	264	
75	100	100	100	100	100	105	121	136	149	
80	100	100	100	100	100	100	100	100	100	
65	100	242	296	342	382	419	483	540	592	74 dBA
70	100	136	166	192	215	235	272	304	333	
75	100	100	100	108	121	132	153	171	187	
80	100	100	100	100	100	100	100	100	105	
65	215	304	373	430	481	527	608	680	745	76 dBA
70	121	171	210	242	270	296	342	383	419	
75	100	100	118	136	152	167	192	215	236	
80	100	100	100	100	100	100	108	121	133	
65	271	383	469	542	605	663	766	856	938	78 dBA
70	152	215	264	305	341	373	431	482	527	
75	100	121	148	171	192	210	242	271	297	
80	100	100	100	100	108	118	136	152	167	
65	341	482	590	682	762	835	964	1078	1181	80 dBA
70	192	271	332	383	429	470	542	606	664	
75	108	152	187	216	241	264	305	341	373	
80	100	100	105	121	136	149	172	192	210	
65	429	607	743	858	960	1051	1214	1357	1487	82 dBA
70	241	341	418	483	540	591	683	763	836	
75	136	192	235	271	303	332	384	429	470	
80	100	108	132	153	171	187	216	241	264	

Table A2 (Cont'd)

Maximum Acceptable Equivalent Sound Level (Leq) for Land Use (dBA)	Estimated Number of 4WD Vehicles Using the Area									Average Sound Level for 4WD Vehicles Using the Area (dBA at 15.24 m)
	5	10	15	20	25	30	40	50	60	
65	540	764	936	1081	1208	1323	1528	1704	1871	84 dBA
70	304	430	526	608	679	744	859	961	1052	
75	171	242	296	342	382	419	483	540	592	
80	100	136	166	192	215	235	272	304	333	
65	680	962	1178	1360	1521	1666	1924	2151	2356	86 dBA
70	382	541	662	765	855	937	1082	1209	1325	
75	215	304	373	430	481	527	608	680	745	
80	121	171	210	242	270	296	342	383	419	
65	856	1211	1483	1712	1915	2097	2422	2708	2966	88 dBA
70	481	681	834	963	1077	1179	1362	1523	1668	
75	271	383	469	542	605	663	766	856	938	
80	152	215	264	305	341	373	431	482	527	
65	1078	1524	1867	2156	2410	2640	3048	3409	3734	90 dBA
70	606	857	1050	1212	1355	1485	1715	1917	2100	
75	341	482	590	682	762	835	964	1078	1181	
80	192	271	332	383	429	470	542	606	664	
65	1357	1929	2350	2714	3034	3324	3838	4291	4701	92 dBA
70	763	1079	1322	1526	1706	1869	2158	2413	2644	
75	429	607	743	858	960	1051	1214	1357	1487	
80	241	341	418	483	540	591	683	763	836	
65	1708	2416	2959	3417	3820	4185	4382	5402	5918	94 dBA
70	960	1359	1664	1921	2148	2353	2717	3038	3328	
75	540	764	936	1081	1208	1323	1528	1704	1871	
80	304	430	526	608	679	744	859	961	1052	

Table A2 (Cont'd)

Maximum Acceptable Equivalent Sound Level (Leq) for Land Use (dBA)	Estimated Number of 4WD Vehicles Using the Area									Average Sound Level for 4WD Vehicles Using the Area (dBA at 15.24 m)
	5	10	15	20	25	30	40	50	60	
65	2150	3042	3725	4301	4809	5268	6083	6801	7450	96 dBA
70	1209	1710	2095	2419	2704	2963	3421	3825	4190	
75	680	962	1178	1360	1521	1666	1924	2151	2356	
80	382	541	662	765	855	937	1082	1209	1325	
65	2707	3829	4690	5415	6054	6632	7658	8562	9379	98 dBA
70	1522	2153	2637	3045	3405	3730	4306	4815	5274	
75	856	1211	1483	1712	1915	2097	2422	2708	2966	
80	481	681	834	963	1077	1179	1362	1523	1668	
65	3408	4821	5904	6817	7622	8349	9641	10779	11808	100 dBA
70	1916	2711	3320	3834	4286	4695	5422	6062	6640	
75	1078	1524	1867	2156	2410	2640	3048	3409	3734	
80	606	857	1050	1212	1355	1485	1715	1917	2100	

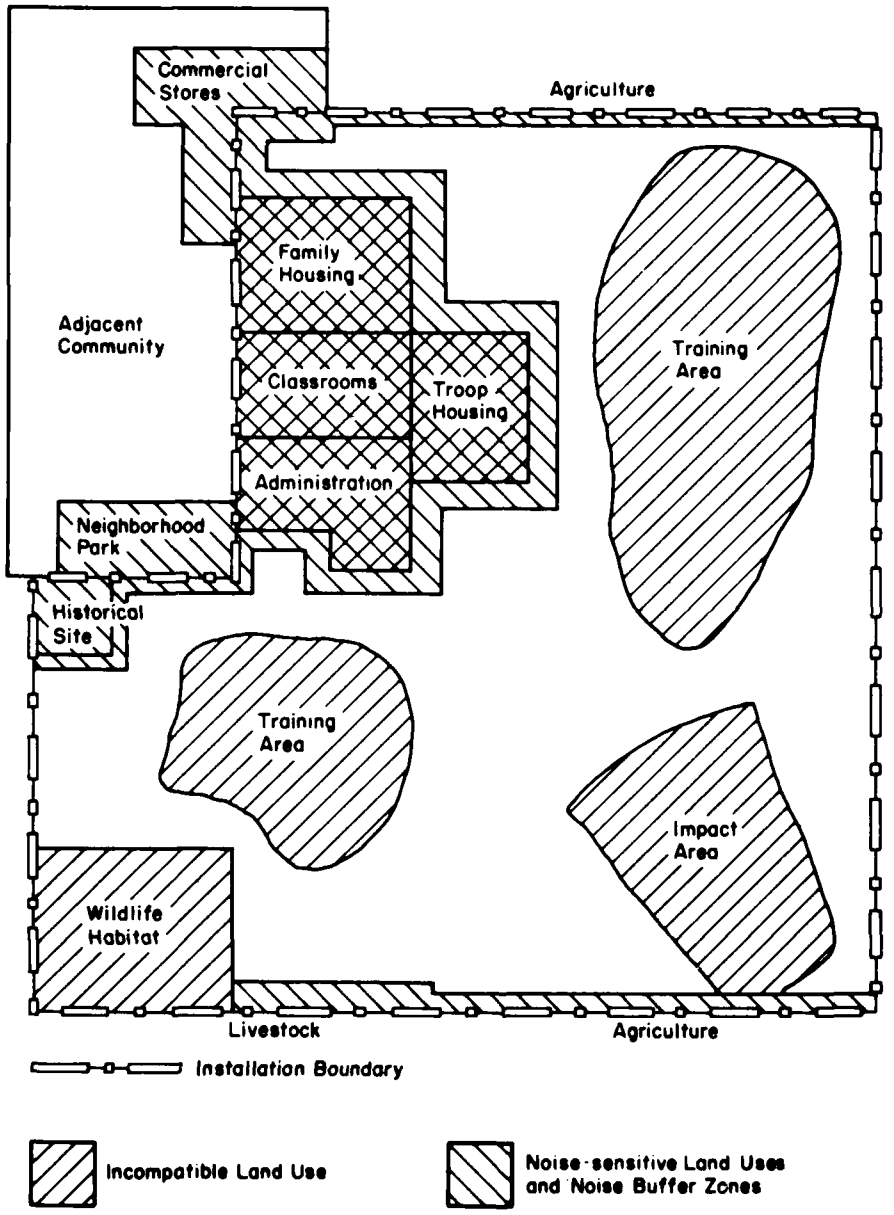

Figure A1. Noise-sensitive land uses and noise buffer zones.

D = The Leq for the land use for which a buffer zone is being established or for which adjacent limited use is necessary (Table A1).

For example, assume that the projected demand for a potential 4WD vehicle trail is an average daily use of 10 vehicles and that each vehicle generates an average of 76 dBA at 15.24 m. Further assume that a noise buffer zone must be established around a family housing area. From Table A1, it is known that the Leq for family housing is 65 dBA; therefore:

A = 15.24 m
B = 76 dBA
C = 10 4WD vehicles
D = 65 dBA for family housing

and:

$$DNNA = 15.24 \times 10^{\left[\frac{76 + 10(\log 10) - (65 - 5)}{20}\right]} \quad \text{[Eq A2]}$$

$$DNNA = 15.24 \times 10^{\left[\frac{76 + 10(1) - 60}{20}\right]} \quad \text{[Eq A3]}$$

$$DNNA = 15.24 \times 10^{\left[\frac{76 + 10 - 60}{20}\right]} \quad \text{[Eq A4]}$$

$$DNNA = 15.24 \times 10^{\left[\frac{26}{20}\right]} \quad \text{[Eq A5]}$$

$$DNNA = 15.24 \times 10^{(1.3)} \quad \text{[Eq A6]}$$

$$DNNA = 15.24 \times 19.95 \quad \text{[Eq A7]}$$

$$DNNA = 304 \text{ m} \quad \text{[Eq A8]}$$

Based on this DNNA calculation, a minimum noise buffer zone of 304 m should be established around the family housing area. In other words, any trail with a projected average daily use of ten 4WD vehicles, each generating an average of 76 dBA, should be located no closer than 304 m from family housing.

The same example is used to illustrate the limited-use alternative for insuring that maximum acceptable sound levels for noise-sensitive land uses are not exceeded. Assume that the projected demand for a potential 4WD vehicle trail is an average daily use of 30 vehicles, each generating 76 dBA at 15.24 m. Further assume that the trail is located 304 m from family housing. Based on the above calculation, if a trail is established along the potential route, the use must be limited to an average daily use of ten vehicles. By

inserting different known variables into the equation, either the size of buffer zones or use limits are determined.

Sound Level (Leq) Requirements for Noise-Sensitive Land Uses

Table A1 lists the Leq ratings of various noise-sensitive areas. This table was adapated from TM 5-803-2, Figure 4-5. The levels shown in TM 5-803-2 assume that a new facility is to be constructed in an existing noise environment, while Table A1 assumes that a new noise-generating land use is being developed adjacent to an existing facility or land use. Therefore, some modification in the sound-level requirements are necessary. Since it is impractical to list all noise-sensitive land uses, any land use suspected to be noise-sensitive should be included in whatever category seems appropriate. Good judgment is essential in this determination.

Precalculated DNNAs

Table A2 lists the DNNA for various Leqs and projected use parameters. Most distances in the table were calculated using Eq A1. To find an appropriate DNNA in Table A2, it is necessary to determine:

1. The Leq of the land use for which a buffer zone is needed or for which use limits must be determined.

2. The average daily use in numbers of 4WD vehicles (projected demand).

3. The average sound level (in dBA) generated by these vehicles.

The average daily use of a proposed trail is perhaps the most difficult parameter to establish. Users and installation outdoor recreation personnel who know how to project recreation demand or who have received user requests are the best sources of local information. The Heritage Conservation and Recreation Service, U.S. Department of the Interior (USDI), and appropriate State agencies can also supply useful information. For the present, these sources may be the only ones available.

To compute the average daily use, estimate the maximum number of 4WD vehicles to be operated in a proposed area for each day of the week, add these numbers, and divide by seven. To insure that noise-level requirements are not exceeded, estimated use should be based on demand for a week when use is expected to be the highest. Estimates of daily use should also be generous to accommodate any unexpected increase in demand.

The noise levels generated by 4WD vehicles vary considerably depending on the type of vehicle, the amount of user modification, and the mode of operation. To accurately estimate the average sound levels generated by 4WD vehicles which will use installation lands, actual noise measurements for a representative sample of vehicles should be taken. On many installations, sound measuring instruments are regularly used by, and may be available from, the Preventive Medicine Office, the Environmental Office, or the Provost Marshal. Generally, users will cooperate in making these measurements. Measurements should be taken in dBA at 15.24 m and in conditions which would

simulate actual recreational use. If the average sound levels generated by 4WD vehicles cannot be measured and accurately estimated, the following are recommended:

1. Use 76 dBA at 15.24 m for the average noise level if most vehicles expected to use the area or trail appear to have nondefective or unmodified muffler systems.

2. Use 80 dBA at 15.24 m for the average noise level if most vehicles expected to use the area or trail appear to have defective or modified muffler systems.

3. Do not allow unlicensed or unmuffled vehicles to operate in the area or along the trail.

Once use parameters are known, the DNNAs for many noise-sensitive land uses can easily be found in Table A2. Table A3 shows how to use Table A2. The example in Figure A1 assumes an Leq of 70 dBA and a projected average daily use of fifteen 4WD vehicles generating an average sound level of 72 dBA. The DNNA is 132 m.

Once the DNNAs for each noise-sensitive land use are determined, noise buffer zones should be marked on an appropriate base map. These lines should be drawn at a distance (corresponding to the scale of the map) which illustrates the minimum distance outside which a 4WD vehicle trail could be located (see Figure A1 for an example). Regardless of the DNNA calculation, noise buffer zones should be a minimum of 100 m.

Table A2 can also be used to establish limits on the use of a potential 4WD vehicle trail. Using the example shown in Table A3, assume that a proposed trail is located 132 m from a playground or active sport recreational area (Leq is 70 dBA in Table A1). Also assume that the 4WD vehicles expected to use the trail generate an average sound level of 72 dBA. Therefore, use of the proposed trail must be limited to an average daily use of 15 vehicles to insure that maximum acceptable sound levels are not exceeded.

Table A3

Finding the DNNA of an Area -- An Example

Maximum Acceptable Equivalent Sound Level (Leq) for Land Use (dBA)	Estimated Number of 4WD Vehicles Using the Area									Average Sound Level for 4WD Vehicles Using the Area (dBA at 15.24 m)
	5	10	15	20	25	30	40	50	60	
65	136	192	235	271	303	332	384	429	470	72 dBA
70	100	108	132	153	171	187	216	241	264	
75	100	100	100	100	100	105	121	136	149	
80	100	100	100	100	100	100	100	100	100	
65	100	242	296	342	382	419	483	540	592	74 dBA
70	100	136	166	192	215	235	272	304	333	
75	100	100	100	108	121	132	153	171	187	
80	100	100	100	100	100	100	100	100	105	
65	215	304	373	430	481	527	608	680	745	76 dBA
70	121	171	210	242	270	296	342	383	419	
75	100	100	118	136	152	167	192	215	236	
80	100	100	100	100	100	100	108	121	133	
65	271	383	469	542	605	663	766	856	938	78 dBA
70	152	215	264	305	341	373	431	482	527	
75	100	121	148	171	192	210	242	271	297	
80	100	100	100	100	108	118	136	152	167	
65	341	482	590	682	762	835	964	1078	1181	80 dBA
70	192	271	332	383	429	470	542	606	664	
75	108	152	187	216	241	264	305	341	373	
80	100	100	105	121	136	149	172	192	210	
65	429	607	743	858	960	1051	1214	1357	1487	82 dBA
70	241	341	418	483	540	591	683	763	836	
75	136	192	235	271	303	332	384	429	470	
80	100	108	132	153	171	187	216	241	264	

APPENDIX B:

SOIL CONSIDERATIONS FOR EVALUATING AREAS FOR RECREATIONAL VEHICLE USE

Introduction

AR 210-9 requires that areas with soil properties which might be adversely affected by ORRVs be eliminated from consideration as ORRV-use areas. To help identify these soil properties, CERL has cooperated with the USDA-SCS in developing a guide for rating soil limitations for off-road motorcycle trails (Table B1). Every SCS-identified soil in the United States has been rated, using the criteria listed in Table B1, for its suitability for trailbike use.

By considering certain distinct differences between trailbikes and 4WD vehicles and their use, the ratings can be used to evaluate areas for recreational 4WD vehicle use. Soil ratings are available from the natural resource offices of TRADOC and FORSCOM and from DARCOM's Natural Resources Section of the Installation and Services Activity. This appendix describes these soil limitations ratings and identifies special considerations for using them to evaluate 4WD vehicle use areas.

How Soils Were Rated

A professional soil scientist can readily use the rating criteria in Table B1 to determine soil limitations ratings for ORRV-use areas. However, it was necessary to develop an alternative procedure so that installation personnel unable to obtain the services of a professional soil scientist could obtain ratings.

Information on every U.S. soil series and phase which SCS has identified and classified is stored in computer files. After each new rating criterion is developed and tested, the soil property information in these files is evaluated and the soils rated according to the criterion. The rating and suitability information for each soil is then printed and distributed. These files were assessed and ratings were developed using the trailbike evaluation criteria (Table B1). This was done using a computer program and with the assistance of the Statistical Laboratory at Iowa State University (where the soil records are kept).

The rating criteria identify eight soil properties which can restrict or limit a soil's suitability for use: (1) USDA texture, (2) the weight percentage of stones greater than 76 mm, (3) depth to high water table, (4) erosion factor (K), (5) slope, (6) unified texture, (7) the weight percentage of coarse fragments less than 76 mm but greater than 2 mm, and (8) flooding. The differences in these properties create up to 11 possible restrictive features. (Note that restrictive feature 12 in Table B1 cannot be determined by computer analysis. It can only be determined in the field by a professional.)

Table B1

Guide for Rating Soil Limitations for ORRV Trails

	Property	Limits: Slight	Moderate	Severe	Restrictive Feature
1.	USDA texture	---	---	ICE	Permafrost
2.	Fraction > 3 in. (86 mm) (wt pct) (surface layer)*	<10	10-25	>25	Large stones
3.	Depth to high water table, (ft)*	>2 ---	1-2 ---	0-1 +	Wetness Ponding
4.	Erosion factor (K) x pct slope	<2	2-4	>4	Erodes easily
5.	USDA texture (surface layer)**	---	---	SC, SIC, C	Too clayey
6.	USDA texture (surface layer)	---	LCOS, VFS	COS, S, FS	Too sandy
7.	Unified (surface layer)	---	---	OL, OH, PT	Excess humus
8.	Slope (pct)	0-25	25-40	>40	Slope
9.	Coarse fragments (wt pct) (surface layer)+	<40	40-65	>65	Small stones
10.	USDA Texture (surface layer)	---	SIL, SI VFSL, L	---	Dusty
11.	Flooding	NONE, RARE, OCCAS	FREQUENT	---	Floods
12.	Other++	---	---	---	Fragile

* 1 in. = 25.4 mm; 1 ft = 0.3048 m.

** Soils in UST, TOR, ARID, BOR, or XER suborders, great groups, or subgroups rate one class better.

\+ 100 minus the percent passing No. 10 sieve.

++ If the soil is easily damaged by use or disturbance, rate as "Severe-Fragile."

The 11 restrictive features in Table B1 are listed in order of their importance as a limiting factor. The properties of each soil in the SCS files were examined in this order. For example, when the computer examined a soil's properties, it searched for an indication of permafrost before it searched for the presence of large stones or wetness. The limitations ratings for a particular soil identify a maximum of three restrictive features; these restrictive features are given in their order of importance. For example, consider a particular soil that has severe limitations because it has a very high water table, erodes easily, is too clayey, and has excess humus. The limitations rating will only indicate that the soil has severe limitations for wetness, erodes easily, and is too clayey. Of the four limitations, these three are considered the most important, as indicated by their order in Table B1.

Soil properties were examined on a worst-case basis, with severe limitations being the worst case. For example, if 15 percent of the weight percentage of a particular soil is due to large stones (a moderate limitation) and another 70 percent is due to small stones (a severe limitation), the soil will be rated as having severe limitations due to small stones. The moderate restriction due to large stones is not indicated in the rating, even though large stones are more important as a restrictive feature. Only the worst-case or most severe limitations and appropriate restrictive features are identified.

How Ratings Are Interpreted

Figure B1 is an example of the soil limitations ratings available from the MACOM Natural Resource offices. The first step in identifying the limitations of soils in a candidate area is to reproduce the soil survey map(s) which correspond to that area. This map should show the location and boundaries of each soil series and/or phase in the candidate area. Next, a list of each series and/or phase in the area should be prepared. This information is obtained from the mapping unit symbols and the map legend found in the survey.

Once this is done, the phase description provided for each mapping unit is compared with the various phase descriptions on the limitation ratings. The soil phase limitation on the ratings list which is closest to the phase description in the survey is the degree of limitation given to the soil or mapping unit. The phase descriptions on the ratings and in the survey do not have to and generally will not correspond exactly. Good judgment should be used to pick the rating which most closely applies to the survey description.

The limitations ratings have the following information.

1. Soil Series. This column lists, in alphabetical order, soil series names for soils identified and classified by the SCS. Often, a series name will be listed two or more times, once by itself and again followed by a property or unit modifier (e.g., stony, moderately wet, flooded). The limitations for a soil unit that is modified by a certain property or characteristic can be very different from the limitations of the unmodified soil.

SOIL SERIES	RECORD NUMBER	DEPTH (IN.)	PHASE	LIMITATION	RESTRICTION
ADELPHIA	NJ0024	0-14	0-6% SL,FSL	MODERATE	WETNESS
			6-10% SL,FSL	MODERATE	WETNESS, ERODES EASILY
			0-6% SIL	MODERATE	WETNESS, DUSTY
			6-10% SIL	MODERATE	WETNESS, ERODES EASILY, DUSTY
ADENA	CO0194	0-3	0-5% L,SIL	MODERATE	DUSTY
			5-11% L,SIL	MODERATE	ERODES EASILY, DUSTY
			11-12% L,SIL	SEVERE	ERODES EASILY
ADGER	MT0001	0-7	0-4% C,SIC	MODERATE	TOO CLAYEY
			4-8% C,SIC	MODERATE	ERODES EASILY, TOO CLAYEY
			0-4% SICL	SLIGHT	
			4-8% SICL	MODERATE	ERODES EASILY
ADILIS	CO0468	0-4	0-8% GR-SL	MODERATE	SMALL STONES
			0-8% GR-L	MODERATE	SMALL STONES, DUSTY
			0-8% SL	SLIGHT	
			0-8% L	MODERATE	DUSTY
ADJUNTAS	PR0063	0-24	40-60% C	SEVERE	ERODES EASILY, TOO CLAYEY
ADKINS, ALKALI	WA0249	0-11	0-3% FSL	MODERATE	WETNESS
ADKINS, GRAVELLY SUBSTRATUM	WA0470	0-4	0-6% FSL	SLIGHT	
			6-13% FSL	MODERATE	ERODES EASILY
			13-25% FSL	SEVERE	ERODES EASILY
ADKINS, WET	WA0623	0-12	0-6% FSL	MODERATE	WETNESS
			6-13% FSL	MODERATE	WETNESS, ERODES EASILY
			13-15% FSL	SEVERE	ERODES EASILY
ADLER	MS0024	0-7	0-2% SICL,RARE,OCCAS	SLIGHT	
			0-2% SICL,FREQ	MODERATE	FLOODS
			0-2% SIL,SI,RARE,OCCAS	MODERATE	DUSTY
			0-2% SIL,SI,FREQ	MODERATE	DUSTY, FLOODS
ADOLPH	MN0188	0-13	0-1% SICL,SIL	SEVERE	WETNESS
ADRIAN	MI0028	0-34	0-2% SP	SEVERE	PONDING, EXCESS HUMUS
AECET	ID0045	0-5	0-12% SL	SLIGHT	
			0-6% L	MODERATE	DUSTY
			6-12% L	MODERATE	ERODES EASILY, DUSTY
AECET, STONY	ID0046	0-5	0-12% STV-SL,STV-LS	SEVERE	LARGE STONES

Figure B1. Sample soil limitations ratings.

2. Record Number. This column contains the record number of each soil series and/or modified series. The SCS uses this number for record-keeping and indicates, by abbreviation, the state in which the soil records are kept. If additional information on a particular soil is needed, this record number can be used in correspondence with the appropriate SCS office. This may occur if there is uncertainty about a rating or to obtain suggestions for soil maintenance procedures.

3. Depth in Inches. Individual soil depths vary considerably, and soil properties vary with depth. These numbers identify the soil depth at which the rating was made. If erosion is deeper, a professional soil scientist should be consulted to determine the correct limitation rating of the exposed soil.

4. Phase. A soil series can have several phases, depending on the slopes on which it is found, its predominant surface texture at a particular location, the presence of stones, flooding potential, and other characteristics. A soils limitation and/or restrictive feature can, and generally does, change from phase to phase. Therefore, based on the rating criteria, all possible phases of a particular soil series are listed in this column. Table B2 lists abbreviations which can be used to interpret phase differences. For example, 6 to 10 percent SL, FSL is one possible phase for a soil found in New Jersey (Adelphia in Figure B1). The abbreviations indicate that the corresponding limitation for this phase is applied to this soil if it is found on 6 to 10 percent slopes and the predominant surface texture is sandy loam or fine sandy loam.

5. Limitation. This column identifies the limitation rating which applies to each soil series phase. The possible limitations are slight, moderate, or severe. Each limitation is defined as follows:

(a) Slight. Given to soil phases that have properties acceptable for use. The degree of limitation is minor, and environmental damage is expected to be below average. Good performance and low maintenance can be expected.

(b) Moderate. Given to soil phases that have properties moderately acceptable for use. The degree of limitation can be overcome or modified by special planning, design, or trail maintenance. Some soils rated as moderate require artificial drainage, control of runoff to reduce erosion, some modification of certain features through manipulation of the soil, etc.

(c) Severe. Given to soils that have one or more properties that are unacceptable for use, such as steep slopes, large stones, flooding, a seasonal high water table, or a high erodibility factor. This degree of limitation generally requires major soil reclamation, special design, or intensive maintenance. Some of these soils, however, can be improved by reducing or removing the soil feature that limits use; however, in most situations, it is difficult and expensive to alter the soil or to design the trail to compensate for a severe degree of limitation.

Table B2

Soil Phase Interpretation Abbreviations

Abbreviations for Texture Modifiers			
BY	Bouldery	GRC	Coarse gravelly
BYV	Very bouldery	GRF	Fine gravelly
BYX	Extremely bouldery	GRV	Very gravelly
CB	Cobbly	MK	Mucky
CBA	Angular cobbly	PT	Peaty
CBV	Very cobbly	SH	Shaly
CN	Channery	SHV	Very shaly
CNV	Very channery	SR	Stratified
CR	Cherty	ST	Stony
CRC	Coarse cherty	STV	Very stony
CRV	Very cherty	STX	Extremely stony
FL	Flaggy	SY	Slaty
FLV	Very flaggy	SYV	Very slaty
GR	Gravelly		

Abbreviation for Texture			
COS	Coarse sand	VFSL	Very fine sandy loam
S	Sand	L	Loam
FS	Fine sand	SIL	Silt loam
VFS	Very fine sand	SI	Silt
LCOS	Loamy coarse sand	SCL	Sandy clay loam
LS	Loamy sand	CL	Clay loam
LFS	Loamy fine sand	SICL	Silty clay loam
LVFS	Loamy very fine sand	SC	Sandy clay
COSL	Coarse sandy loam	SIC	Silty clay
SL	Sandy loam	C	Clay
FSL	Fine sandy loam		

Abbreviations for Terms Used in Lieu of Texture			
CE	Coprogeneous earth	MARL	Marl
CEM	Cemented	MPT	Mucky-peat
DE	Diatomaceous earth	MUCK	Muck
FB	Fibric material	PEAT	Peat
FRAG	Fragmental material	SG	Sand and gravel
G	Gravel	SP	Sapric material
GYP	Gypsiferous material	UWB	Unweathered bedrock
HM	Hemic material	VAR	Variable
ICE	Ice or frozen soil	WB	Weathered bedrock
IND	Indurated	CIND	Cinders

Table B2 (Cont'd)

Abbreviations for Frequency of Flooding	
NONE	NONE (No reasonable possibility of flooding)
RARE	RARE (Flooding unlikely but possible under abnormal conditions)
COMMON	COMMON (Flooding likely under normal conditions)
OCCAS	OCCASIONAL (Less often than once in 2 years)
FREQ	FREQUENT (More often than once in 2 years)
PROT	PROTECTED (Soil protected from flooding; e.g., levees)

6. Restriction. This column identifies the restrictive feature which resulted in a soil phase being given a moderate or severe limitation (e.g., too sandy, floods). No restrictions are given if the phase has only slight limitations.

For an example of interpreting the limitations rating for a particular phase, consider the Adena soil series given in Figure B1. This soil series is found in Colorado; and records of its properties are on file at the Colorado State SCS office under the record number C00194. Limitations ratings for various phases of this soil apply to the first 76.2 mm of soil. If the soil is found on 0 to 5 percent slopes and the predominant texture is loam (L) or silt loam (SIL), it has moderate limitations because it is dusty. If the same textures are found on 5 to 11 percent slopes, it also has moderate limitations. However, the principal restrictive feature in this case is that it erodes easily on these slopes (even though it is still dusty).

In most soil surveys, a few areas will be mapped but not identified as containing a singular soil series or phase. These may be areas where the soils have been disturbed, such as landfills; areas where the soil exhibits no particular properties which would give it a special classification (alluvial soils); areas with a variety of intermingled series such that it would be difficult to plot their boundaries on a map; and/or areas where no soil has developed, such as granite outcrops. In these cases, identifying of a degree of limitation may be difficult since they will not be listed in the limitations ratings.

Often, a soil survey will have brief written descriptions of these mapping units. These descriptions can be compared to the rating criteria to estimate the degree of limitations. However, for most cases, a professional soil scientist should be consulted to obtain a more accurate estimate.

The SCS soil files are continually updated, and the criteria used to develop the ratings have not been extensively tested. Thus, SCS personnel have recommended that use of the ratings and the soil evaluation method be coordinated with and/or reviewed by local SCS field personnel. This will insure that problems which might produce environmental damage will be identified early. Finally, because of the unique nature of tropical and permafrost soils, it is strongly recommended that a professional soil scientist be consulted concerning the ratings for soils in Alaska and Hawaii.

APPENDIX C:

METHOD TO BIOLOGICALLY RATE AREAS FOR OFF-ROAD RECREATIONAL VEHICLE USE

This appendix describes a method for making a biological examination and assessment of potential ORRV use areas. The method is systematic and is designed to be used even if quantitative data are not available. It requires a site visit and visual survey of alternative areas, and the input of a professional biologist. Alternative candidate areas can be rated in two ways: (1) the "relative value" of the biological resources of alternative areas as compared with the rest of the installation, or (2) the "susceptibility to ORRV damage" of alternative areas. (The latter is used if the biologist is familiar with the types of damage produced by ORRVs.) For both methods, year-round as well as seasonal conditions should be considered.

User Instructions

The following instructions are accompanied by an example for a hypothetical area. Figure C1 illustrates the example for the "relative value" approach. Figure C2 illustrates the example for the "susceptibility to ORRV damage" approach. Figure C3 is a blank copy of the form used in Figures C1 and C2. The circled numbers by each step in the instructions refer to corresponding numbers in Figures C1 and C2; they illustrate the portion of the rating form which relates to each step.

The "Relative Value" Approach

1. Area. Assign a special designation to each area for identification (e.g., " Area 1"). If a candidate area represents two or more distinct biological communities, each community should be considered separately.

2. Biological Resources. Several categories of biological resources are listed in this column (e.g., "Ground Cover" or "Trees or Dominant Vegetation"). Under each category, list specific biological resources known to exist either in the area being examined or on the installation (e.g., "Ash Juniper" or "Live Oak"). If dominant vegetation can be placed into both "Ground Cover" and "Trees or Dominant Vegetation," it should be included in both categories. "Terrestrial Nongame Animals" includes both birds and reptiles. If a water body or stream is in or near the area being examined, include fish. Identify any other species or biological factor which is not easily categorized by listing it under the category "Other." The list of biological resources should be compiled from existing data; however, a site visit is also required. The last column in the special rating form is for any remarks or notes needed to help rate an area.

3. Relative Value. Rate each listed biological resource in this column. The value of the resources at each site should be rated relative to their value to the rest of the installation. When determining this value, consider the past, present, and future carrying capacity of the area in relation to the rest of the installation. The relative value is determined using the following five-point scale:

(1) Area AREA 1

(6) Rating 3.6 Rank 2 (8)

(7) Biological Limitation TERRESTRIAL GAME ANIMALS. EXCEPTIONALLY GOOD HABITAT FOR FOX SQUIRREL AND BOBWHITE

(2) Resources	(3) Relative Value	(4) Categorical Value	Susceptibility to ORRV Damage	Categorical Susceptibility	Combined Resource Value	Notes
Ground Cover		3				
GRASSES	2					ON ROCKY SURFACES
LICHENS	3					
Trees or Dominant Vegetation		4				
ASHE JUNIPER	2					
LIVE OAK	4					
Terrestrial Game Animals		5				
WHITE-TAILED DEER	3					MANY DEN TREES
FOX SQUIRREL	5					
EASTERN COTTONTAIL	4					
BOBWHITE	5					
MOURNING DOVE	4					
TURKEY	2					
Terrestrial Nongame Animals		3				
TEXAS MOUSE	3					
COLLARED LIZARD	2					
TURKEY VULTURE	2					
LARK SPARROW	3					
CARDINAL	3					
Fish		3				
LONGNOSED GAR	1					
CARP	2					
FLATHEAD CATFISH	1					
GIZZARD SHAD	2					
CHANNEL CATFISH	3					
Pest species		3				
STARLING	2					WINTERING AREA, PERIODIC HIGH CONCENTRATIONS
BLACK RAT	2					
RATTLESNAKE	3					
Other		4				
DEN TREES	4					
(5) Total Area Value		25	Total Combined Resource Value			

Figure C1. The "relative value" approach to ORRV use potential.

Area AREA 1

(5) Rating 136 Rank 3 (7)

Biological Limitation TERRESTRIAL GAME ANIMALS, PARTICULARLY THE PRESENCE OF FOX SQUIRREL

(1) Resources	Relative Value	Categorical Value	(2) Susceptibility to ORRV Damage	(3) Categorical Susceptibility	(4) Combined Resource Value	Notes
Ground Cover		3		4	12	
GRAYES CACTUS	2/3		2/4			ON ROCKY SURFACES
Trees or Dominant Vegetation		4		3	12	
ASHE JUNIPER LIVE OAK	2 4		3 3			
Terrestrial Game Animals		5		5	25	
WHITE-TAILED DEER FOX SQUIRREL EASTERN COTTONTAIL BOBWHITE MOURNING DOVE TURKEY	3 5 4 5 4 2		3 5 2 2 2 4			MANY DEN TREES
Terrestrial Nongame Animals		3		3	9	
TEXAS MOUSE COLLARED LIZZARD TURKEY VULTURE LARK SPARROW CARDINAL	3 2 3 3		2/3 2 3 3			
Fish		3		4	12	
LONGNOSED GAR CARP FLATHEAD CATFISH GIZZARD SHAD CHANNEL CATFISH	1 2 1 2 3		2 2 2 3 4			
Pest species		3		3	9	
STARLING BLACK RAT RATTLESNAKE	2/3 3		4 3 3			WINTERING AREA / PERIODIC HIGH CONCENTRATIONS
Other		4		4	16	
DEN TREES	4		4			
Total Area Value			Total Combined Resource Value		95	

Figure C2. The "susceptibility to ORRV damage" approach to ORRV use potential.

Area _____

Rating _____ Rank _____

Biological Limitation _____

_____

Resources	Relative Value	Categorical Value	Susceptibility to ORRV Damage	Categorical Susceptibility	Combined Resource Value	Notes
Ground Cover						
_____						
Trees or Dominant Vegetation						
_____						
Terrestrial Game Animals						
_____						
Terrestrial Nongame Animals						
_____						
Fish						
_____						
Pest species						
_____						
Other						
_____						
	Total Area Value		Total Combined Resource Value			

Figure C3. Biological rating form for ORRV use potential.

a. The resource has little importance at this location when compared to the rest of the installation.

b. The resource has some importance at this location, but its value is somewhat below average as compared to the rest of the installation.

c. The resource at this location is representative of the entire installation.

d. This area is one of the better examples of this resource relative to the rest of the installation. The value of the resource at this location can be described as somewhat above average.

e. This area is one of the very best examples of this resource as compared to the rest of the installation. The value of the resource at this location can be described as much more valuable than at other locations on the installation.

4. Categorical Value. Next, determine the "relative value" of each resource category for which biological resources were identified. To do this, take the highest individual biological resource value under each category and assign that value to the entire category. For example, in Figure 1, the biological resources "Ashe Juniper" and "Live Oak" have been given values of 2 and 4, respectively. Since "Live Oak" was given a value of 4, the entire resource category of "Trees or Dominant Vegetation" should be given a value of 4 — the highest "relative value" in the category.

5. Total Area Value. Determine the "relative value" of the entire area by adding the category values. For example, the total area value of 25 in Figure C1 was determined by adding the values for the categories "Ground Cover," "Trees or Dominant Vegetation," "Terrestrial Game Animals," "Terrestrial Nongame Animals," "Fish," "Pest Species," and "Other."

6. Rating. Determine the area's biological rating by dividing the total area value by the number of resource categories for which values have been determined. In Figure C1, 25 has been divided by 7 for a value of 3.6. If the category "Other" had not contained a value, the total area value would have been divided by 6. After determining the area rating, write it in the space provided near the top of the form. This allows a quick comparison of alternative areas.

7. Biological Limitation. The area's biological limitation of the area must be noted for decision-making purposes. The biological limitation is the resource category which has received the highest "categorical" value. For example, in Figure C1, the biological limitation is the presence of "Terrestrial Game Animals," particularly Fox Squirrel and Bobwhite. The biological limitation shows which resource most restricts ORRV use in the area. When describing the limitation, briefly explain the importance of the resource. Word the explanation so a nonbiologist can understand the logic.

8. Rank. The final step is ranking alternative areas by comparing the biological ratings and limitations of each area. Rank the area with the lowest numerical rating (No. 1); this area is the most acceptable for ORRV use. Rank the area with the seond lowest rating No. 2. Indicate any area

with a biological rating of greater than or equal to 4 as unacceptable. An area with an overall rating of 4 indicates that it is one of the better examples of biological resources relative to the rest of the installation; therefore, it should not be used. If two areas receive the same rating, use judgment to determine the importance of the biological limitation before ranking the areas. The most important area biologically should always receive the highest numerical value.

The "Susceptibility to Damage" Approach

This approach is used only if the biologist feels qualified to determine how susceptible the resources in the area are to damage.

1. Initial Steps. The first steps of this approach are the same as the first four listed in the "relative value" approach. After completing those steps, follow the steps listed below.

2. Susceptibility to ORRV Damage. Determine the susceptibility to damage of each biological resource listed under the resource categories, assign a susceptibility value to each resource. Since the importance of damage to various resources is perceived differently, use the two scales described below to assign the values. One scale applies to all resource categories except "Pest Species"; the other is used exclusively for "Pest Species."

Susceptibility to Damage for All Nonpest Categories

a. This resource will receive some damage because of ORRV use. Recovery time would be within 1 year, OR the area is already so badly damaged from other factors that it has no logical present or future biological value.

b. This resource will be damaged by ORRV use. Recovery time would be 1 to 5 years.

c. ORRV use would be destructive to this resource. Recovery time would be 5 to 10 years.

d. ORRV use would be highly destructive. Recovery time would be 10 to 100 years.

e. ORRV use would be extremely destructive to this resource. If use is allowed, the recovery time would be greater than 100 years.

Susceptibility to Damage for Pest Species

a. ORRV use would not increase this species through habitat improvement and/or a reduction in competition OR any prediction of decrease in the species is also indicated by a value of 1.

b. ORRV use would slightly increase this species.

c. A moderate increase in this species is expected because of ORRV use.

d. A large increase in this species is expected due to ORRV use.

e. ORRV use would reduce competition and/or improve habitat for this species; thus, a very large increase in the pest population is expected.

3. Categorical Susceptibility. Determine the "susceptibility to ORRV damage" for each resource category by assigning the susceptibility value of the resource which received the highest relative value to the entire category. For example, in Figure C2, the biological resource "Fox Squirrel" has a relative value of 5. Since it is the highest "relative value" for any resource in the category "Terrestrial Game Animals," the entire category receives a "susceptibility to ORRV damage" value of 5 — the susceptibility value for Fox Squirrel.

4. Combined Resource Value. Determine the combined value of each resource category by multiplying the relative values by the susceptibility to damage values. In Figure C2, the "relative value" of the category "Ground Cover," 3, is multiplied by the "susceptibility to ORRV damage" value, 4. This results in a combined resource value of 12. Determine the combined resource value of the entire area by adding the combined resource values for each category. In Figure C2, this results in a total combined resource value of 95.

5. Rating. Determine the biological rating for the entire area by dividing the total combined resource value by the number of resource categories for which combined resource values have been determined. In Figure C2, 95 has been divided by 7 for a rating value of 13.6. (Note that if the category "Other" had not contained a susceptibility value, the area's combined resource value would have been divided by 6.) As in the "relative value" approach, the area rating is placed in the space provided on the evaluation form.

6. Biological Limitation. To help in the decision-making process, an area's biological limitation must be recorded. Determine the limitation by examining the combined resource value of each resource category. The highest individual category value determines the biological limitation. In Figure C2, the limiting factor is "Terrestrial Game Animals." This resource category has a combined resource value of 25 — the highest of all categories. In this case, the presence of Fox Squirrels (which will be significantly affected by ORRV use) presents the greatest biological restriction.

7. Rank. To rank areas, compare the biological rating for each alternative. Rank the area with the lowest numerical rating No. 1. The area with this ranking is the most acceptable for ORRV use. Any area which has a rating of greater than or equal to 16 is not normally acceptable for ORRV use. A rating of 16 or greater indicates that the area has excellent resources relative to the rest of the installation, and ORRV use would be relatively more destructive.

Ranking Interpretation

As stated in the instructions to both approaches, the area which receives the lowest numerical rating is ranked No. 1. The area with the second lowest numerical rating is ranked No. 2. The area ranked No. 1 is more acceptable for ORRV use than the area ranked No. 2. To make evaluations comparable, the same rating approach is used for each area being evaluated. When choosing a site for ORRV use, special consideration should be given to areas ranked No. 1 or 2. If possible, the use area should be the one ranked No. 1. This will help minimize damage to the installation's biological resources as required by AR 210-9 and AR 200-2.

APPENDIX D:

METHOD OF MONITORING ENVIRONMENTAL EFFECTS OF OFF-ROAD RECREATIONAL VEHICLE USE*

1. Estimate use of the area or trails by 4WD vehicle users.

2. Determine impact of ORRV use on vegetation and soil.

a. Map existing trails in designated ORRV area.

b. Record mileage and average width of existing trails.

c. Rate existing trails according to light, medium, or heavy use.

d. Select random sample plots on and along existing trails which are representative of a variety of terrain, vegetative, and soil conditions.

(1) Photograph sample plots.

(2) Record trail width and rut depths at selected intervals. Also record other notable features, such as potholes, along entire trail length.

(3) Inventory the vegetative community within the sample plots. This inventory should include species composition, size of woody vegetation, and number of dead stems greater than 20 mm in diameter.

(4) Record the general condition of vegetation in the sample plot. Note damaged tree bark and roots and the condition of herbaceous vegetation.

e. Record initially, and at intervals of 1, 3, and 5 years, those items included in d above.

f. Define control plots near test plots to determine impact with and without ORRV use. Control plots should be about 18 m from the trail center. Record all appropriate information on control plots for comparison with sample plots.

g. Permanently, but inconspicuously, mark all control and test plots so that photographs and data collection can be done in the same area in subsequent years.

h. Determine the following from test sections:

(1) Impact on young vegetative growth.

(2) Impact on larger trees and shrubs (compaction, direct damage, root exposure).

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* *This method is not intended to take the place of a disciplined scientific study, but is a limited method designed to monitor effects while taking into consideration budgetary constraints and personnel ceilings.*

(3) Impact on soil (erosion, compaction, lateral movement).

(4) Trail width and depth variation from year to year.

(5) Extent of impact on either side of trail. Changes in trail such as expansion of potholes and ruts.

(6) Comparison of impact on test plots with control plots.

i. Annually spot-check vulnerable areas such as steep slopes, creek banks, and lake shoreline. Record any noticeable increases in erosion or other damage.

3. Determine impact on wildlife.

a. Record track counts of big game animals such as deer, antelope, and elk in ORRV area and compare to those outside ORRV area.

b. Count game birds and nongame birds by their songs.

c. If hunting is permitted, compare wildlife harvest in the ORRV area to that of other areas on the installation.

d. Record sightings of game and nongame species in and outside ORRV use area.

4. Determine ORRV impact on other activities.

a. Survey type and amount of recreation and other use in areas adjacent to designated ORRV areas.

b. Record as accurately as possible the attitudes of persons who are surveyed.

c. Record distance between area where survey is made and the ORRV area.

APPENDIX E:
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APPENDIX F:
BIBLIOGRAPHY

This bibliography is intended for persons, including Army installation and MACOM natural resources and environmental personnel, who want to examine a variety of published technical and general studies related to off-road recreational vehicle use.

This bibliography was derived from (1) referenced materials in other published works, (2) telephone and mail solicitation of known or potential authors and publishers of related materials, and (3) examination of available documents and articles on the general subject of ORVs. Most of the cited articles have been examined for direct, rather than general, applicability to the subject.

References are arranged in three sections. The first section contains references that pertain to the planning and management of ORRV areas. The second section deals specifically with the environmental impact of ORRV's and includes relevant environmental impact statements or related assessment documents. The third section lists Army-sponsored and Army-scientific documents, including technical reports of Army research laboratories. All three sections are further divided into general, trailbike, snowmobile, and 4WD categories.

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